



US Army Corps  
of Engineers  
Baltimore District

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# CONSTRUCTION SPECIFICATIONS

## RENOVATION OF CONMY HALL, BUILDING 241

### FORT MYER MILITARY COMMUNITY, VIRGINIA

REQUEST FOR PROPOSAL **W912DR-04-R-0054**

CONTRACT NO.

DATE **JUL 23, 2004**

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SECTION 01000

ADMINISTRATIVE REQUIREMENTS  
01/01

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Title Evidence

Proof of purchase for equipment and/or materials.

Invoice Copies

Proof of rental equipment costs.

Photographs

Photographs and, as applicable, negatives showing construction progress.

SD-03 Product Data

Cost or Pricing Data

Proof of actual equipment costs.

Equipment Data

An itemized list of serial/model numbers and equipment installed by the Contractor under this contract..

SD-05 Design Data

Progress Schedule; G AR.

A schedule that shows the manner in which the Contractor intends to prosecute the work.

SD-10 Operation and Maintenance Data

O and M Data

A list of proposed maintenance and instruction manuals that is mainly used for but not limited to customized equipment.

#### Commissioning Activity for HVAC; G AR

The Contractor shall provide a separate activity for commissioning. Commissioning shall start only after all HVAC related work has been completed and all HVAC O&M manuals have been submitted and approved by the Government.

### 1.2 PROGRESS SCHEDULING AND REPORTING (DEC 1998)

#### 1.2.1 Practicable Progress Schedule

The Contractor shall, within 20 days after date of commencement of work or as otherwise determined by the Contracting Officer, submit for approval a practicable progress schedule in accordance with specification Section 01320 PROJECT SCHEDULE showing the manner in which he intends to prosecute the work.

#### 1.2.2 Software Package

The Contractor shall utilize an industry recognized QCS-W compatible scheduling software package to implement the requirements of Section 01320 PROJECT SCHEDULE. The program and data must be IBM PC compatible in a Window environment. These requirements are not intended to restrict the Contractors selection of an automated scheduling system but to establish a format which will allow use of the same program with government computers and automated information systems. The Contractor will provide at least one program installation and maintenance on government hardware complete with all program and data files. Such installation shall be maintained for the duration of the project until fiscal completion and shall allow analysis and of the project schedule by government personnel or agents.

#### 1.2.3 Additional Scheduling Requirements

The Contractor shall incorporate the following requirements in addition to those specified in Section 01320 PROJECT SCHEDULE.

#### 1.2.4 Preparation of Operation and Maintenance (O&M) Manuals

The Contractor shall provide a separate activity for the preparation and submission of all O&M manuals. The associated cost of \$2,000 shall be assessed for this activity.

#### 1.2.5 Commissioning Activity for HVAC

The Contractor shall provide a separate activity for commissioning of the HVAC system. The activity shall be as a minimum 15 days long. The associated cost shall be \$62,000. Commissioning shall start only after all HVAC related work has been completed and all HVAC O&M manuals have been submitted and approved by the Government.

#### 1.2.6 Additional Commissioning Requirements

Provide separate activities for commissioning of systems shown below. Each activity shall be as a minimum duration as shown below and shall have an appropriate associated cost.

- a. Electrical Interior 15 in Duration \$7,000 Cost
- c. Fire Alarm System 15 in Duration \$1,000 Cost
- d. Sound System 15 in Duration \$6,000 Cost
- e. Theatrical Lighting System 15 in Duration \$9,000 Cost

##### 1.2.6.1 Shake-Out Commissioning and Dress Rehearsal

Provide commissioning of Performance Hall, with all operable systems and controls in concert with each other, a minimum of 6 weeks prior to the Contracting Officer-accepted Project Completion Date.

This "Shake-Out" Commissioning is not to exceed 1 (one) working day.

Refer to Section 01451 CONTRACTOR QUALITY CONTROL for requirements for this activity.

#### 1.3 PAYMENTS TO CONTRACTORS: (NOV 1976)

For payment purposes only, an allowance will be made by the Contracting Officer of 100 percent of the invoiced cost of materials or equipment delivered to the site but not incorporated into the construction, pursuant to the Contract Clause entitled "PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS". The Contracting Officer may also, at his discretion, take into consideration the cost of materials or equipment stored at locations other than the jobsite, when making progress payments under the contract. In order to be eligible for payment, the Contractor must provide satisfactory evidence that he has acquired title to such material or equipment, and that it will be utilized on the work covered by this contract. Further, all items must be properly stored and protected. Earnings will be computed using 100% of invoiced value. (CENAB-CO-E)

#### 1.4 IDENTIFICATION OF EMPLOYEES: (OCT 1983)

Each employee assigned to this project by the Contractor and subcontractors shall be required to display at all times, while on the project site, an approved form of identification provided by the Contractor, as an authorized employee of the Contractor/subcontractor. In addition, on those projects where identification is prescribed and furnished by the Government, it shall be displayed as required and it shall immediately be returned to the Contracting Officer for cancellation upon release of the assigned employee and or completion of project. (CENAB)

#### 1.5 PURCHASE ORDER: (SEP 1975)

One readable copy of all purchase orders for material and equipment,

showing firm names and addresses, and all shipping bills, or memoranda of shipment received regarding such material and equipment, shall be furnished the appointed Contracting Officer's Representative as soon as issued. Such orders, shipping bills or memoranda shall be so worded or marked that all material and each item, piece or member of equipment can be definitely identified on the drawings. Where a priority rating is assigned to a contract, this rating, the required delivery date, and the scheduled shipping date shall also be shown on the purchase order. At the option of the Contractor, the copy of the purchase order may or may not indicate the purchase price. (CENAB-CO-E)

1.6 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE (EFARS 52.0231.5000 (OCT 1995))

(a) This clause does not apply to terminations. See 52.249-5000, Basis for settlement of proposals and FAR Part 49.

(b) Allowable cost for construction and marine plant and equipment in sound workable conditions owned or controlled and furnished by a contractor or subcontractor at any tier shall be based on actual costs data for each piece of equipment or groups of similar serial and services for which the government can determine both ownership and operating costs from the contractor's accounting records. When both ownership and operating costs can not be determined for any piece of equipment or groups of similar serial or series equipment from the contractor's accounting records, costs for that equipment shall be based upon the applicable provisions of EP1110-1-8 Construction Equipment Ownership and Operating Expenses Schedule, Region East. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the contracting officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retroactive pricing, the schedule in effect at the time the work was performed shall apply.

(c) Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d) (ii) and Far 31.205-36. Rates for equipment rented from an organization under common control, lease-purchase arrangements, and sale-leaseback arrangements, will be determined using the schedule, except that actual rates will be used for equipment leased from an organization under common control that has an established proactive of leasing the same or similar equipment to unaffiliated leasees.

(d) When actual equipment costs are proposed and the total amount of the pricing action exceeds the small purchase threshold, the contracting officer shall request the contractor to submit either certified cost or pricing data, or partial/limited data, as appropriate. The data shall be submitted on Standard Form 1411, Contract Pricing Proposal Cover Sheet. CENAB-CT/SEP 95 (EFARS 52.231-5000)

1.7 REAL PROPERTY EQUIPMENT DATA: (APR 1975)

At or before the time of completion of the contract, the Contractor shall



submit to the Contracting Officer a complete itemized list, including serial and model number where applicable, showing the unit retail value of each Contractor furnished item of mechanical, electrical and plumbing equipment installed by the Contractor under this contract. For each of the items which is specified herein to be guaranteed for a specified period from the date of acceptance thereof, either for beneficial use or final acceptance, whichever is earlier, against defective materials, design, and workmanship, the following information shall be given: the name, address and telephone number of the Subcontractor, Equipment Supplier, or Manufacturer originating the guaranteed item. The list shall be accompanied by a copy of the specific guarantee document for each item which is specified herein to be guaranteed if one had been furnished to the Contractor by the Equipment Supplier or Manufacturer. The Contractor's guarantee to the Government of these items will not be limited by the terms of any manufacturer's guarantee to the Contractor. Baltimore District NADB Form 1019 may be utilized for the itemized listing and will be made available to the Contractor upon request. (CENAB-CO-E)

1.8 O and M DATA: (JUL 1979)

The requirements for furnishing operating and maintenance data and field instruction are specified elsewhere in the specifications. The Contractor shall submit to the Contracting Officer, at a time prior to the 50% project completion time, a list of proposed maintenance and instruction manuals to be furnished the Government and the scheduled dates of all required field instructions to be provided by Contractor furnished personnel or manufacturer's representatives. All maintenance and instruction manuals must be furnished to the Contracting Officer at least 2 weeks prior to the scheduled dates of any required Contractor furnished field instructions or at least one month prior to project completion if no Contractor furnished field instructions are required. (CENAB)

1.9 FACILITY SECURITY CLEARANCE:

All contractor/subcontractor personnel must follow all rules governing Fort Myer. All contractor personnel must register with the installation security office and obtain an installation identification pass. The identification pass shall be presented when entering the installation and shall be carried at all times while on the installation property. All contractor personnel must demonstrate United States citizenship or appropriate paperwork to work legally in the United States. 1.10 HOT-WORK PERMIT

A hot-work permit, DA Form 5383-R (copy attached to the end of this section), must be submitted to the post DPW before using heat-producing equipment.

1.11 NEGOTIATED MODIFICATIONS: (OCT 84)

Whenever profit is negotiated as an element of price for any modification to this contract with either prime or subcontractor, a reasonable profit shall be negotiated or determined by using the OCE Weighted Guidelines method outlined in EFARS 15.902. (Sugg. NAB 84-232)

1.12 PHOTOGRAPHS

PHOTOGRAPHIC COVERAGE: (SEP 85) The Contractor shall provide photographic coverage under the contract. These services shall be for ten commercial grade color photographs every three months from the beginning of the contract until acceptance of the completed work. These photographs shall be in 8" x 10" size and shall be taken at intervals and at the place designated by the Contracting Officer. Negatives from all of the above photographs shall be given to and become the property of the Government.  
(CENAB-CO)

1.13 PARTNERING: (NOV 92)

In order to most effectively accomplish this contract, the Government is willing to form a cohesive partnership with the Contractor and its subcontractors. This partnership would strive to draw on the strengths of each organization in an effort to achieve a quality project done right the first time, within budget and on schedule. This partnership would be bilateral in make-up and participation will be totally voluntary. Any cost associated with effectuating this partnership will be agreed to by both parties and will be shared equally with no change in contract price.  
(CENAB-EN-DT)

1.14 REVIEWS / APPROVALS / PERMITS

The approvals listed below have been obtained by the Government or are in the approval process. After final approvals by the respective agencies are received, the Government will furnish approval letters to the Contracting Officer who will furnish the Contractor all such approvals before or during construction. The Contractor shall abide by all requirements.

Virginia State Historic Preservation Office approval of project.

b. National Capital Planning Commission approval of project.

c. Commission of Fine Arts approval of project.

PART 2 PRODUCTS

NOT APPLICABLE

PART 3 EXECUTION

NOT APPLICABLE

ATTACHMENTS:

Hot-Work Permit Form DA 5383-R

-- End of Section --

## HOT-WORK PERMIT

For use of this form, see AR 420-90; the proponent agency is ACSIM

1. LOCATION	2. DATE	3. PERMIT NO.
4. TYPE OF WORK	5. START TIME	6. FINISH TIME
7.a. NAME OF PERSON RESPONSIBLE FOR HOT-WORK AT JOB SITE <i>(Contractor/Government Employee)</i>	7.b. SIGNATURE	

### PRECAUTIONS BEFORE OPERATIONS

CHECKLIST	CHECK ONE	
	YES	NO
8. Did Fire Department Inspector inspect site?		
9. Are there procedures for Fire Department emergency notification? <i>(Emergency No.)</i>		
10. Are combustibles in area noted?		
11. Should combustibles be covered? <i>(If yes, note in remarks)</i>		
12. Are proper extinguishers on hand?		
13. Is wet-down necessary? <i>(If yes, note in remarks)</i>		
14. Is smoking permissible at work sites?		
15. Is continuous fire watch required?		
16. Is Fire Department standby required?		
17. Are other precautions required? <i>(If yes, note in remarks)</i>		
18.a. FIRE DEPARTMENT INSPECTOR'S SIGNATURE	18.b. DATE	

### PRECAUTIONS AFTER OPERATIONS

CHECKLIST	CHECK ONE	
	YES	NO
19.a. Was Fire Department notified after hot-work operation was completed?		
19.b. Time:		
20.a. Did Fire Department inspector inspect work site?		
20.b. Time:		
21. Are after work conditions safe? <i>(If no, note in remarks)</i>		
22. Are heat producing devices safe if left at work site?		
23.a. FIRE DEPARTMENT INSPECTOR'S SIGNATURE	23.b. DATE	
24. REMARKS		

**NOTE: PERMIT VALID ON DAY OF OPERATION AT ONE LOCATION ONLY**

SECTION 01050

JOB CONDITIONS  
09/03

PART 1 GENERAL

1.1 LAYOUT OF WORK

ALTERNATE 4: (FOR MILITARY PROJECTS) REHABILITATION OF STRUCTURES.

LAYOUT OF WORK: (APR 1972) The Contractor shall lay out his work and shall be responsible for all measurements in connection therewith. The Contractor shall furnish, at his own expense, all templates, platforms, equipment, tools and materials and labor as may be required in laying out any part of the work. The Contractor will be held responsible for the execution of the work to such lines and elevations shown on the drawings or indicated by the Contracting Officer. (CENAB)

1.2 PHYSICAL DATA: (APR 1984)

Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation or conclusion drawn from the data or information by the Contractor. (CENAB)

1.2.1 Transportation Facilities

FORT MYER, VA.

Fort Myer is ringed by two primary roads; Arlington Boulevard (U.S. Route 50) on the northern and northwestern sides and Washington Boulevard (State Route 27) on the southwestern side. Public transportation is available to and from the post. No rail service is available at the present time.

1.2.2 Explorations

The physical conditions indicated on the drawings and in the specifications are the result of site investigations by surveys .

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be

submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shut Down Utility Services; G, AR.

Prior approval for service/utility interruptions.

Checklist; G, AR

A Risk Assessment for excavation and other work in the vicinity of utilities.

Impact Submittals; G, AR

Items that could impact normal base activities.

SD-07 Certificates

Operations Statement

Written proof that the boilers have been properly installed and are operating satisfactorily in accordance with the manufacturer's instructions.

1.4 UTILITIES

1.4.1 Availability of Utilities Including Lavatory Facilities: (JUN 1980)

It shall be the responsibility of the Contractor to provide all utilities he may require during the entire life of the contract. He shall make his own investigation and determinations as to the availability and adequacy of utilities for his use for construction purposes and domestic consumption. He shall install and maintain all necessary supply lines, connections, piping, and meters if required, but only at such locations and in such manner as approved by the Contracting Officer. Before final acceptance of work under this contract, all temporary supply lines, connections and piping installed by the Contractor shall be removed by him in a manner satisfactory to the Contracting Officer. (CENAB)

1.4.2 Interruption of Utilities: (1972)

a. No utility services shall be interrupted by the Contractor to make connections, to relocate, or for any purpose without approval of the Contracting Officer.

b. Request for permission to shut down utility services shall be submitted in writing to the Contracting Officer not less than 17 days prior to proposed date of interruption. The request shall give the following information:

c. Nature of Utility (Gas, L.P. or H.P., Water, Etc.)

d. Size of line and location of shutoff.

- e. Buildings and services affected.
- f. Hours and date of shutoff.
- g. Estimated length of time service will be interrupted.
- h. Services will not be shut off until receipt of approval of the proposed hours and date from the Contracting Officer.
- i. Shutoffs which will cause interruption of Government work operations as determined by the Contracting Officer shall be accomplished during regular non-work hours or on non-work days of the Using Agency without any additional cost to the Government.
- j. Operation of valves on water mains will be by Government personnel. Where shutoff of water lines interrupts service to fire hydrants or fire sprinkler systems, the Contractor shall arrange his operations and have sufficient material and personnel available to complete the work without undue delay or to restore service without delay in event of emergency.
- k. Flow in gas mains which have been shut off shall not be restored until the Government inspector has determined that all items serviced by the gas line have been shut off. (CENAB)

#### 1.4.3 Utility Markings

The Contractor shall contact the installation/DPW and the One-Call Service, a minimum of 14 days and 48 hours, respectively, prior to any excavation requesting utility location markings. The Contractor shall not proceed with any excavation until all utilities, including abandoned utilities, have been marked to the satisfaction of the Contracting Officer. Prior to requesting the marking of utilities, the Contractor shall stake out proposed excavations and limits of work with white lines ("White Lining"). It is the Contractor's responsibility to ensure that all permits (excavation or otherwise, including DPW permits) are current and up-to-date without expiration. In addition to the above requirements the Contractor shall:

- a) Visually survey and verify that all utility markings are consistent with existing appurtenances such as manholes, valve boxes, poles, pedestals, pad-mounted devices, gas meters, etc. prior to any excavation.
- b) Hand dig test holes to verify the depth and location of all utilities prior to any mechanical excavation within the limits of work. Other non-damaging methods for utility verification, as indicated in (d) below, may be considered subject to approval by the Contracting Officer. Also, verify that any abandoned utilities are not active.
- c) Preserve all utility markings for the duration of the project to the furthest extent possible.

- d) When excavation is performed within 2 feet of any utility line, a non-damaging method of excavation shall be used. The non-damaging method shall be hand digging. Other non-damaging methods, such as, soft digging, vacuum excavation, pneumatic hand tools, may be considered subject to approval by the Contracting Officer.
- e) Regardless of the type of excavation, the Contractor shall notify the Contracting Officer a minimum of 72 hours prior to any excavation activity. Failure to notify the Contracting Officer can result in the issuance of a "Stop Work" order, which shall not be justification for contract delay or time extension. The Government reserves the right to have personnel present on site during any type of excavation.
- f) The Contractor's Quality Control System Manager shall ensure that all excavation requirements herein are met at the time of the preparatory phase of quality control, and that the excavation procedures are reviewed during the preparatory phase meeting. This preparatory phase of control shall also establish and document contingency plans and actions to be followed in the event that existing utilities are damaged or interrupted. Locations of shut off or isolation devices along with other safety features shall be established and their operation reviewed.
- g) Any work other than excavation in the vicinity of a utility, that could damage or interrupt a utility, such as, exterior or interior work near transformers, power lines, poles, above ground gas lines, gas meters, etc., shall be done with extreme care. The Contractor shall specifically note during the preparatory phase of quality control, the construction techniques to be used to preclude damaging or interrupting any utility. This preparatory phase of control shall also establish and document contingency plans and actions to be followed in the event that existing utilities are damaged or interrupted. Locations of shut off or isolation devices along with other safety features shall be established and their operation reviewed.
- h) The Contractor shall complete a risk assessment, using the attached checklist, at least one week prior to the start of any excavation or other work in the vicinity of a utility. The risk assessment shall be submitted for government approval prior to any excavation or other work in the vicinity of a utility. A risk assessment shall be completed for each definable feature of work encountering utilities and shall include all utilities anticipated to be encountered.

#### 1.5 DISPOSAL OF EXISTING MATERIAL AND EQUIPMENT: (DEC 1975)

All removed, dismantled or demolished material and/or equipment including rubble, scrap and debris not specified or indicated to be Government salvaged, reinstalled under this contract or otherwise retained for disposal on Government land will become the property of the Contractor and shall be promptly removed from the site and disposed of by the Contractor



at his own expense and responsibility. (CENAB)

1.6 COMPLIANCE WITH POST/BASE REGULATIONS: (JUL 1980)

The site of the work is on a military reservation and all rules and regulations issued by the Commanding Officer covering general safety, security, sanitary requirements, pollution control, traffic regulations and parking, shall be observed by the Contractor. Information regarding these requirements may be obtained by contacting the Contracting Officer, who will provide such information or assist in obtaining same from appropriate authorities. (MEMO)

1.6.1 Impact Submittals

The Contractor shall submit to the Contracting Officer, in writing, permission for meetings, inspections, digging permits, street closings, shutdown of utilities, and other items that could impact normal base activities, not less than 15 days prior to date of proposed interruption.

1.7 ACCESS TO FACILITY: (DEC 1975)

The Contractor shall have full access to the facility, including access to all parts of the building and use of the parking area to the west as indicated on the drawings.(CENAB)

1.8 PROTECTION OF GOVERNMENT PROPERTY AND PERSONNEL: (DEC 1975)

1.8.1 Protection of Equipment

All existing Government owned equipment within the work area shall be protected by the Contractor from damage caused by construction operations. As a minimum, the Contractor shall cover all furniture, equipment and carpets in the work area with dust barriers and protect such items from any damage due to dust, vibration, water, heat or other conditions resulting from construction activities. Existing work damaged by construction operations shall be promptly repaired by the Contractor at his own expense.

1.8.2 Protection of Personnel

The Contractor shall protect occupants of the building by installing safety rails and/or barricades as applicable to prevent injury from unauthorized entry of personnel into work areas. Warning signs shall be erected as necessary to indicate Construction areas or hazardous zones. Work shall proceed in such manner as to prevent the undue spread of dust and flying particles.

1.8.3 Measures to Prevent Damage/Injury

The Contractor shall take such additional measures as may be directed by the Contracting Officer to prevent damage or injury to Government property or personnel. (CENAB)

## 1.9 STREET CLOSINGS: (MAY 1978)

When operations in connection with contract work necessitate the closing of streets, it shall be the Contractor's responsibility to arrange in advance with the Contracting Officer for such street closings and to provide appropriate barricades, signs, markers, flares, and other devices as may be required by the Contracting Officer's Representative for traffic guides and public safety. (CENAB)

## 1.10 CONTRACTOR USE OF HEATING PLANT: (1968) (MOD 1975)

## 1.10.1 Utilization of the Installed Heating System

The Contractor may, at his option, utilize the heating system installed under this contract to provide space heating prior to the time of completion of the building. All fuel-oil for such space heating and for the required tests of heating equipment shall be furnished by the Contractor and shall be of the type and grade specified.

## 1.10.2 Operations Statement

The heating system shall be operated only by qualified personnel and shall be operated with all auxiliaries and in accordance with the manufacturer's instructions and good operating practice. Boilers shall not be operated for space heating until the Contracting Officer is furnished a written operations statement signed by the Contractor certifying that all water treating equipment, combustion control equipment, and the boiler safety controls have been properly installed and are operating satisfactorily. When a boiler is to be shut down for a period of more than 5 days, the combustion chamber and the fire sides of all boiler tubes shall be cleaned thoroughly immediately after shutdown. If at any time the Contracting Officer determines that the equipment is being improperly operated or maintained, the Contractor may be directed to discontinue its use.

## 1.10.3 Controlled Temperature

Heating systems shall be operated and controlled to prevent temperature in any room or space in the building from exceeding 90 degrees F

## 1.10.4 Renovating the New Heating System

The Contractor shall, prior to the time of final acceptance of all work under this contract, place the heating system and related equipment in a condition equal to new. The combustion chamber and fire side of all boiler tubes shall be cleaned, burner nozzles shall be cleaned and adjusted, and air filters, and pipeline strainers shall be replaced or cleaned, as required. (CENAB)

## 1.11 ASBESTOS (JAN 1985 REV NOV 1993)

## 1.11.1 WARNING

THE CONTRACTOR IS WARNED THAT EXPOSURE TO AIRBORNE ASBESTOS HAS BEEN ASSOCIATED WITH FOUR DISEASES: LUNG CANCER, CERTAIN GASTROINTESTINAL

CANCERS, PLEURAL OR PERITONEAL MESOTHELIOMA AND ASBESTOSIS. Studies indicate there are significantly increased health dangers to persons exposed to asbestos who smoke and further, to family members and other persons who become indirectly exposed as a result of the exposed worker bringing asbestos-laden work clothing home to be laundered.

#### 1.11.2 Friable and/or Nonfriable Asbestos

The Contractor is advised that friable and/or nonfriable asbestos containing material has been identified in area(s) where contract work is to be performed. Friable asbestos containing material means any material that contains more than 1 percent asbestos by weight that hand pressure can crumble, pulverize or reduce to powder when dry. Nonfriable asbestos containing materials do not release airborne asbestos fiber during routine handling and end-use. However, excessive fiber concentrations may be produced during uncontrolled abrading, sanding, drilling, cutting, machining, removal, demolition or other similar activities. Whether asbestos is friable or nonfriable, care must be taken to avoid releasing or causing to be released, asbestos fibers into the atmosphere where they may be inhaled or ingested.

#### 1.11.3 Potential Locations

When contract work activities are carried out in locations where the potential exists for exposure to airborne asbestos fibers as described in paragraph "Friable and/or Nonfriable Asbestos" above or where asbestos waste will be generated, the contractor shall assure that all measures necessary to provide effective protection to persons from exposure to asbestos fibers and prevention of contamination to property, materials, supplies, equipment and the internal and external environment are effectively instituted. The Contractor shall conduct asbestos-related activities in accordance with SECTION: 13280 - ASBESTOS ABATEMENT.

#### 1.11.4 Summarization

The Contractor shall complete and return to the Contracting Officer within 15 working days after the completion of all airborne asbestos monitoring conducted under this contract, a "Summarization of Airborne Asbestos Sampling Results" form provided by the Government. This completed summarization form is to be used by the US Army Corps of Engineers for statistical information purposes and does not relieve the Contractor from his recordkeeping requirements as specified in SECTION: 13280 - ASBESTOS ABATEMENT. A copy of this summarization form is attached to the end of this section.

#### 1.11.5 Industrial Hygiene Asbestos Survey

An industrial hygiene asbestos survey was conducted in the contract work area(s) to identify the presence of asbestos containing materials as described in paragraph "Friable and/or Nonfriable Asbestos" above. The data collected is contained in the ASBESTOS SURVEY REPORT ("Asbestos-Containing Materials, Lead-Based Paint, PCB Containing Light Ballasts, and Mercury Containing Components Survey Report") inserted at the end of this section.

## 1.11.6 Additional Asbestos Survey

The industrial hygiene asbestos survey described in the above paragraph may not have identified all asbestos containing materials in the contract work area(s). When contract work area(s) appear to have asbestos containing material not identified in the SURVEY REPORT, the Contractor shall conduct an asbestos survey to identify such material(s) in a manner similar to that described in the SURVEY REPORT. (CENAB)

The points of contact follow:

1. OSHA: (410)962-2840
2. EPA, Region 3: 1-800-438-2474
5. Virginia Council on the Environment: (804) 786-4508

## 1.12 LEAD-BASED PAINT

The Contractor is advised that lead-based paint has been identified in areas where contract work is to be performed.

## 1.12.1 Potential Locations

When contract work activities are carried out in locations where the potential exists for exposure to lead-based paint, the contractor shall assure that all measures necessary to provide effective protection to persons from exposure to lead-based paint and prevention of contamination to property, materials, supplies, equipment and the internal and external environment are effectively instituted. The Contractor shall conduct lead-based paint-related activities in accordance with SECTION: 13283 - REMOVAL / CONTROL AND DISPOSAL OF PAINT WITH LEAD.

## 1.12.2 Lead-Based Paint Survey

A lead-based paint survey was conducted in the contract work area(s) to identify the presence of lead-containing paint. The data collected is contained in the SURVEY REPORT ("Asbestos-Containing Materials, Lead-Based Paint, PCB Containing Light Ballasts, and Mercury Containing Components Survey Report") inserted at the end of this section.

## 1.12.3 Additional Lead Survey

The lead-based paint survey described in the above paragraph may not have identified all lead-based paint in the contract work area(s). When contract work area(s) appear to have lead-based paint not identified in the SURVEY REPORT, the Contractor shall conduct a lead-based paint survey to identify such material(s) in a manner similar to that described in the SURVEY REPORT.

## 1.13 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

## 1.13.1 Procedure for Determination

This provision specifies the procedure for determination of time extensions for unusually severe weather in accordance the contract clause entitled "Default: (Fixed Price Construction)". In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

- a. The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.
- b. The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

## 1.13.2 Anticipated Adverse Weather Delays

The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY  
WORK DAYS BASED ON (5) DAY WORK WEEK

(b) WALTER REED, FORT MYER, FORT McNAIR, CAMERON STATION, ARLINGTON HALL STATION, ARLINGTON NATIONAL CEMETERY AND USSAH

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
4	5	6	7	6	6	6	5	2	5	4	3

## 1.13.3 Impact

pon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph "Anticipated Adverse Weather Delays", above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)".

1.14 WORKING HOURS

Contractor work hours will be from 08:00 to 16:30, Monday through Friday, unless otherwise approved by the Government.

1.14.1 Work Outside Regular Hours

Work outside regular working hours requires Contracting Officer approval. Make application 15 calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the Contracting Officer may approve work outside regular hours. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer. Make utility cutovers after normal working hours or on Saturdays, Sundays, and Government holidays unless directed otherwise.

1.14.2 Exclusionary Period

No work shall be performed during the period 16:30 to 8:00, inclusive, without prior written approval of the Contracting Officer. This period has not been considered in computing the time allowed for the performance of this contract.

PART 2 PRODUCTS

NOT APPLICABLE

PART 3 EXECUTION

NOT APPLICABLE

ATTACHMENT

RISK ASSESSMENT CHECKLIST

Eng Form 4921-R: Summarization of Airborne Asbestos Sampling Results

SURVEY REPORT: "Asbestos-Containing Materials, Lead-Based Paint, PCB Containing Light Ballasts, and Mercury Containing Components Survey Report"

-- End of Section --

RISK ASSESSMENT FOR  
EXCAVATION AND OTHER WORK IN THE VICINITY OF UTILITIES

PROJECT NAME: \_\_\_\_\_  
CONTRACT NUMBER: \_\_\_\_\_  
PROJECT INSTALLATION AND LOCATION: \_\_\_\_\_  
PROPOSED EXCAVATION START DATE: \_\_\_\_\_

1. ☐ ESTABLISH EXCAVATION DETAILS AND DRAWINGS (check when completed)
2. ☐ PROPOSED EXCAVATION AREA MARKED ("white lining") (check when completed)
3. ☐ CONTACT APPROPRIATE ONE-CALL SERVICE FOR PUBLIC UTILITIES:  
MD: Miss Utility 1-800-257-7777      N Y : New York City - Long Island One Call Center 1-800-272-4480  
N. VA: Miss Utility 1-800-552-7777      PA: Pennsylvania One-Call System Incorporated 1-800-242-1776  
VA: Miss Utility of VA 1-800-552-7001      DC: Miss Utility 1-800-257-7777  
ONE-CALL NATIONAL REFERRAL CENTER: 1-888-258-0808  
  
☐ CONTACT INSTALLATION/OWNERS OF ALL PRIVATELY OWNED UTILITIES (NON ONE-CALL MEMBERS)
4. ☐ DATE UTILITIES MARKED AND METHOD OF MARKING  
ONE-CALL LOCATORS \_\_\_\_\_  
OTHER LOCATORS \_\_\_\_\_
5. ☐ CONTACT APPROPRIATE DPW REPRESENTATIVES AND COMPLY WITH INSTALLATION PERMIT REQUIREMENTS: \_\_\_\_\_
6. ☐ UTILITIES IDENTIFIED ON-SITE:  
☐ NONE ☐ ELECTRIC ☐ GAS ☐ WATER ☐ TELEPHONE ☐ CATV ☐ SEWER ☐ OTHER \_\_\_\_\_
7. ☐ LEVEL OF RISK: (Based upon personnel safety and consequences of utility outages.)  
☐ SEVERE: Excavation required within the immediate vicinity (<2-ft) of a MARKED utility.  
☐ MODERATE: Excav. required outside the immediate vicinity (> 2-ft) of MARKED utility.  
☐ MINIMAL: Excavation required in an area with NO utilities.
8. ☐ EXISTING FACILITIES/UTILITIES IN VICINITY:  
☐ NON-CRITICAL ☐ MISSION CRITICAL ☐ HIGH-PROFILE ☐ CEREMONIAL  
☐ OTHER \_\_\_\_\_  
☐ CONSEQUENCES IF EXISTING UTILITIES ARE DAMAGED/DISRUPTED \_\_\_\_\_
9. ☐ ENGINEERING CONTROLS REQUIRED:  
☐ NONE ☐ HAND EXCAVATE TO LOCATE UTILITY ☐ EXCAVATE WITH DUE CARE  
☐ OTHER \_\_\_\_\_
10. ☐ ADMINISTRATIVE CONTROLS REQUIRED:  
☐ Notification of Contracting Officer's Representative, NOTIFIED on: \_\_\_\_\_  
☐ Notification of Installation/DPW Representative, NOTIFIED on: \_\_\_\_\_
11. ☐ EMERGENCY NOTIFICATION AT INSTALLATION: POC & PHONE NUMBER \_\_\_\_\_

THE INFORMATION NOTED ABOVE IS ACCURATE AND THE WORK IS READY TO PROCEED  
SIGNED and DATE \_\_\_\_\_ CQC MANAGER

12. ☐ ON-SITE GOVERNMENT REP. RECOMMENDATION FOR APPROVAL TO EXCAVATE:  
☐ YES ☐ NO SIGNATURE AND DATE: \_\_\_\_\_  
Comments: \_\_\_\_\_
13. ☐ AREA ENGINEER APPROVAL TO EXCAVATE:  
☐ APPROVED ☐ DENIED SIGNATURE AND DATE: \_\_\_\_\_  
Comments: \_\_\_\_\_
14. ☐ CHIEF, \_\_\_\_\_ DIVISION APPROVAL TO EXCAVATE:  
☐ APPROVED ☐ DENIED SIGNATURE AND DATE: \_\_\_\_\_  
Comments: \_\_\_\_\_

SUMMARIZATION OF AIRBORNE ASBESTOS SAMPLING RESULTS				
CORPS DISTRICT		WORK LOCATION(Installation, Building, Room, City, State)		CONTRACT NO.
AMOUNT OF ASBESTOS _____ SQ. FT. _____ LINEAR FT. WORK AREA DIMENSIONS _____ L x _____ W x _____ H				
ASBESTOS INVOLVED	<input type="checkbox"/> FRIABLE <input type="checkbox"/> NON-FRIABLE			
TYPE OF MATERIAL	<input type="checkbox"/> CEILING TILE <input type="checkbox"/> FLOOR TILE <input type="checkbox"/> SPRAY-ON <input type="checkbox"/> ROOFING <input type="checkbox"/> WALL PANELS <input type="checkbox"/> CLOTH			
	<input type="checkbox"/> PIPE LAGGING <input type="checkbox"/> PLASTER MUD <input type="checkbox"/> PAPER SHEET <input type="checkbox"/> GASKET <input type="checkbox"/> ROPE <input type="checkbox"/> OTHER			
TYPE OF ACTION	<input type="checkbox"/> REMOVAL <input type="checkbox"/> ENCLOSURE <input type="checkbox"/> ENCAPSULATION <input type="checkbox"/> OTHER			
WET METHODS	<input type="checkbox"/> ON WORK <input type="checkbox"/> ON WASTE <input type="checkbox"/> AMENDED WATER <input type="checkbox"/> NOT USED			
WASTE HANDLING	<input type="checkbox"/> SHIFT END <input type="checkbox"/> 2x/SHIFT <input type="checkbox"/> CONTINUOUS <input type="checkbox"/> ACCEPTABLE			
BARRIER FILMS	<input type="checkbox"/> FLOOR <input type="checkbox"/> WALL <input type="checkbox"/> CEILING <input type="checkbox"/> DOUBLE <input type="checkbox"/> AIR VENTS <input type="checkbox"/> OTHER <input type="checkbox"/> NONE			
WORK ZONE PRESSURE DIFFERENTIAL	<input type="checkbox"/> NEGATIVE <input type="checkbox"/> POSITIVE <input type="checkbox"/> AMBIENT <input type="checkbox"/> NONE			
CAUTION SIGNS	<input type="checkbox"/> PERIMETER <input type="checkbox"/> DUMPSTER <input type="checkbox"/> WASTE BAGS			
SITE ISOLATION	<input type="checkbox"/> PERIMETER <input type="checkbox"/> AIRLOCK <input type="checkbox"/> DUCTS <input type="checkbox"/> OTHER			
WORK PRACTICES	<input type="checkbox"/> HEPA VACUUM <input type="checkbox"/> MICROTRAP <input type="checkbox"/> CHANGE ROOM <input type="checkbox"/> SHOWERS			
RESPIRATORS	<input type="checkbox"/> SUPPLY AIR <input type="checkbox"/> PAPR <input type="checkbox"/> SINGLE USE <input type="checkbox"/> REUSABLE <input type="checkbox"/> NONE			
PROTECTIVE CLOTHING	<input type="checkbox"/> DISPOSABLE <input type="checkbox"/> REUSABLE <input type="checkbox"/> SHOE COVERS <input type="checkbox"/> GLOVES			

CEILING VALUES		TWA-VALUES				
FIBERS/CC	OPERATION	FIBERS/CC	SAMPLE HRS.	A/P*	B/D/P/O**	OPERATION

\*\* B/D/P/O (B-Baseline; D-Daily; P-Post-Clean; O-Other)

ABIH CERTIFICATION NO.	
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**ACM, LBP & PCB/MERCURY SURVEY REPORT  
WILL BE ISSUED BY AMENDMENT**

SECTION 01060

SAFETY  
01/01

PART 1 GENERAL

1.1 APPLICABLE PUBLICATION

The publications listed below form a part of this specification and are referred to in the text by the basic designation only. All interim changes (changes made between publications of new editions) to the U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, will be posted on the Headquarters Website. The date that it is posted shall become the official effective date of the change and contracts awarded after this date shall require to comply accordingly. The website location where these changes can be found is under the button entitled "Changes to EM", located at: "[http://www.hq.usace.army.mil/soh/hqusace\\_soh.htm](http://www.hq.usace.army.mil/soh/hqusace_soh.htm)".

U.S. ARMY CORPS OF ENGINEERS:

EM 385-1-1	(3 Sep 1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Safety Supervisor; G AR.

A safety supervisor shall be responsible for overall supervision of accident prevention activities.

Activity Phase Hazard Analysis Plan; G AR.

The addressing of the activity phase hazard analysis plan for each activity performed in a phase of work.

Outline Report

A report for each past activities review.

OSHA Log

## SD-07 Certificates

### Language Certification

It is the Contractors responsibility to ensure that all employees understand the basic english language.

A log shall be reported monthly for injuries.

### 1.3 GENERAL

The U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, and all subsequent revisions referred to in the Contract Clause ACCIDENT PREVENTION of this contract, are hereby supplemented as follows:

a. The Contractor shall designate an employee responsible for overall supervision of accident prevention activities. Such duties shall include: (1) assuring applicable safety requirements are (a) communicated to the workers in a language they understand (reference EM 385-1-1, September 1996, 01.A.04). It is the Contractor's responsibility to ascertain if there are workers on the job who do not speak and/or understand the English language, if such workers are employed by the prime contractor or subcontractors, at any tier, it is the prime contractor's responsibility to insure that all safety programs, signs, and tool box meetings are communicated to the workers in a language they understand, and that a bilingual employee is on site at all time. If the contractor contends that interpreters and/or bilingual signs are not required, language certification must be provided which verifies that all workers (whose native tongue is other than English) have a command of the English language sufficient to understand all direction, training and safety requirements, whether written or oral, and (b) incorporated in work methods, and (2) inspecting the work to ensure that safety measures and instructions are actually applied. The proposed safety supervisor name and qualifications shall be submitted in writing for approval to the Contracting Officer's Representative. This individual must have prior experience as a safety engineer or be able to demonstrate his/her familiarity and understanding of the safety requirements over a prescribed trial period. The safety engineer shall have the authority to act on behalf of the Contractor's general management to take whatever action is necessary to assure compliance with safety requirements. The safety supervisor is required to be on the site when work is being performed.

b. Prior to commencement of any work at a job site, a preconstruction safety meeting shall be held between the Contractor and the Corps of Engineers Area/Resident Engineer to discuss the Contractor's safety program and in particular to review the following submittals:

(1) Contracts Accident Prevention Plan: An acceptable accident prevention plan, written by the prime Contractor for the specific work and implementing in detail the pertinent requirements of EM 385-1-1, shall be submitted for Government approval.

(2) Activity Phase Hazard Analysis Plan: Prior to beginning each

major phase of work, an activity hazard analysis (phase plan) shall be prepared by the Contractor for that phase of work and submitted to the Contracting Officer's Representative for approval. A phase is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew is to perform work. The analysis shall address the hazards for each activity performed in the phase and shall present the procedures and safeguards necessary to eliminate the hazards or reduce the risk to an acceptable level.

c. Subsequent jobsite safety meetings shall be held as follows:

(1) A safety meeting shall be held at least once a month for all supervisors on the project to review past activities, to plan ahead for new or changed operations and to establish safe working procedures to anticipated hazards. An outline report of each monthly meeting shall be submitted to the Contracting Officer's Representative.

(2) At least one safety meeting shall be conducted weekly, or whenever new crews begin work, by the appropriate field supervisors or foremen for all workers. An outline report of the meeting giving date, time, attendance, subjects discussed and who conducted it shall be maintained and copies furnished the designated authority on request.

#### 1.4 ACCIDENTS

Chargeable accidents are to be investigated by both Contractor personnel and the Contracting Officer.

##### 1.4.1 Accident Reporting, ENG FORM 3394

Section 1, Paragraph 01.D, OF EM 385-1-1 and the Contract Clause entitled ACCIDENT PREVENTION are amended as follows: The prime Contractor shall report on Eng Form 3394, supplied by the Contracting Officer, all injuries to his employees or subcontractors that result in lost time and all damage to property and/or equipment in excess of \$2,000 per incident. Verbal notification of such accident shall be made to the Contracting Officer within 24 hours. A written report on the above noted form shall be submitted to the Contracting Officer within 72 hours following such accidents. The written report shall include the following:

a. A description of the circumstances leading up to the accident, the cause of the accident, and corrective measures taken to prevent recurrence.

b. A description of the injury and name and location of the medical facility giving examination and treatment.

c. A statement as to whether or not the employee was permitted to return to work after examination and treatment by the doctor, and if not, an estimate or statement of the number of days lost from work. If there have been days lost from work, state whether or not the employee has been re-examined and declared fit to resume work as of the date of the report.

1.4.2 OSHA Requirements

1.4.2.1 OSHA Log

A copy of the Contractor's OSHA Log of Injuries shall be forwarded monthly to the Contracting Officer.

1.4.2.2 OSHA Inspections

Contractors shall immediately notify the Contracting Officer when an OSHA Compliance official (Federal or State representative) presents his/her credentials and informs the Contractor that the workplace will be inspected for OSHA compliance. Contractors shall also notify the Contracting Officer upon determination that an exit interview will take place upon completion of the OSHA inspection. (NABSA OCT 05, 1976)

1.5 GOVERNMENT APPROVAL

Submittals shall be in accordance with Section 01330 SUBMITTAL PROCEDURES. All required submittals of items specified in this section shall be for information only, except for those items including, but not limited to, the following which shall be submitted for Government approval:

- a. Written designation of safety representative.
- b. Written project specific accident prevention plan.
- c. Written activity phase hazard analysis plan.

PART 2 PRODUCT  
NOT APPLICABLE

PART 3 EXECUTION  
NOT APPLICABLE

-- End of Section --

SECTION 01200

WARRANTY REQUIREMENT  
01/01

PART 1 GENERAL

1.1 WARRANTY OF CONSTRUCTION

The Contractor shall warranty all materials and workmanship in accordance with Contract Clause (FAR 52.246-21), "WARRANTY OF CONSTRUCTION"

1.2 MANUFACTURER'S WARRANTY:

The Contractor shall provide manufacturer's warranties, when available, on all equipment for one year starting from the day of facility acceptance by the Government. Any warranty offered by the manufacturer for periods greater than one year or required by other sections of the specifications shall also be provided.

1.3 WARRANTY PAYMENT

Warranty work is a subsidiary portion of the contract work, and has a value to the Government of \$60,000. The Contractor will assign a value of that amount in the breakdown for progress payments mentioned in the Contract Clause (FAR 52.232-5) "Payments Under Fixed-Price Construction". If the Contractor fails to respond to warranty items as provided in paragraph CONTRACTOR'S RESPONSE TO WARRANTY SERVICE REQUIREMENTS below, the Government may elect to acquire warranty repairs through other sources and, if so, shall backcharge the Contractor for the cost of such repairs. Such backcharges shall be accomplished under the Contract Clause (FAR 52.243-4) "CHANGES" of the contract through a credit modification(s).

1.4 PERFORMANCE BOND:

The Contractor's Performance Bond will remain effective throughout the construction warranty period and warranty extensions.

1.4.1 Failure to Commence

In the event the Contractor or his designated representative(s) fail to commence and diligently pursue any work required under this clause, and in a manner pursuant to the requirements thereof, the Contracting Officer shall have the right to demand that said work be performed under the Performance Bond by making written notice on the surety. If the surety fails or refuses to perform the obligation it assumed under the Performance Bond, the Contracting Officer shall have the work performed by others, and after completion of the work, may demand reimbursement of any or all expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

## 1.5 PRE-WARRANTY CONFERENCE:

Prior to contract completion and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this specification. Communication procedures for Contractor notification of warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be reviewed at this meeting. The Contractor shall provide names, addresses, and telephone numbers of all subcontractors, equipment suppliers, or manufacturers with specific designation of their area of responsibilities if they are to be contacted directly on warranty corrections. This point of contact will be located within the local service area of the warranted construction, will be continuously available, and will be responsive to Government inquiry on warranty work action and status. Minutes of the meeting will be prepared by the Government and signed by both, the Contractor and the Contracting Officer. The minutes shall become part of the contract file.

## 1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-04 Samples

## Sample Tags.

To identify the warranty for all Contractor and Government furnished equipment which the Contractor installs.

## 1.7 ADDITIONAL REQUIREMENTS

## 1.7.1 Equipment Warranty Identification Tags:

The Contractor shall provide warranty identification tags on all Contractor and Government furnished equipment which he has installed.

## 1.7.1.1 Format and Size for Tags

The tags shall be similar in format and size to the exhibits provided by this specification, they shall be suitable for interior and exterior locations, resistant to solvents, abrasion, and to fading caused by sunlight, precipitation, etc. . These tags shall have a permanent pressure-sensitive adhesive back, and they shall be installed in a position that is easily (or most easily) noticeable. Contractor furnished equipment that has differing warranties on its components will have each component tagged.

1.7.1.2 Sample Tags

Sample tags shall be filled out representative of how the Contractor will complete all other tags. These tags shall be submitted to the Government.



## 1.7.1.3 Tags for Warranted Equipment:

The tag for this equipment shall be similar to the following. Exact format and size will be as approved.

EQUIPMENT WARRANTY CONTRACTOR FURNISHED EQUIPMENT	
MFG: _____	MODEL NO.: _____
SERIAL NO.: _____	CONTRACT NO.: _____
CONTRACTORS NAME: _____	
CONTRACTOR WARRANTY EXPIRES: _____	
MFG WARRANTY(IES) EXPIRE: _____	

EQUIPMENT WARRANTY GOVERNMENT FURNISHED EQUIPMENT	
MFG: _____	MODEL NO.: _____
SERIAL NO.: _____	CONTRACT NO.: _____
DATE EQUIPMENT PLACED IN SERVICE: _____	
MFG WARRANTY(IES) EXPIRES: _____	

## 1.7.1.4 Execution

The Contractor will complete the required information on each tag and install these tags on the equipment by the time of and as a condition of final acceptance of the equipment. All tags shall be mechanically attached to the equipment as directed by the Contracting Officer.

## 1.7.1.5 Equipment Warranty Tag Replacement.

The contractor shall provide new tags on repaired or replaced equipment during the warranty period. The tag shall be identical to the original tag, except that the Contractor's warranty expiration date shall be updated to show the correct warranty expiration date.

## 1.8 CONTRACTOR'S RESPONSE TO WARRANTY SERVICE REQUIREMENTS.

## 1.8.1 Notification to Warranty Service Requirements

Following oral or written notification by authorized representative of the installation designated in writing by the Contracting Officer, the Contractor shall respond to warranty service requirements in accordance with the "Warranty Service Priority List" and the three categories of priorities listed below.

## 1.8.1.1 Categories of Priorities

- a. First Priority Code 1: Perform on site inspection to evaluate situation, determine course of action, initiate work within 24 hours and work continuously to completion or relief.
- b. Second Priority Code 2: Perform on site inspection to evaluate situation, determine course of action, initiate work within 48 hours and work continuously to completion or relief.
- c. Third Priority Code 3: All other work to be initiated within 5 work days end work continuously to completion or relief.

## 1.8.1.2 Warranty Service Priority List

## AIR CONDITIONING SYSTEM:

## Code 1:

- b. Buildings with computer equipment.
- c. Commissary and Main PX.
- d. Clubs.
- e. Barracks, mess halls, BOQ/BEQ (entire building down).

## Code 2:

- a. Recreational support.
- b. Air conditioning leak in part of building, if causing damage.

- c. Admin buildings with ADP equipment not on priority list.

DOORS:

Code 1:

- a. Overhead doors not operational

ELECTRICAL:

Code 1:

- a. Power failure (entire area or any building operational after 1600 hours).
- c. Security lights.

Code 2:

- a. Power failure (no Power to a room or part of building),
- b. Receptacle and lights.
- c. Fire alarm systems.

GAS

Code 1

- a. Leaks and breaks.

HEAT

Code 1

- b. Commissary and Main PX.
- c. Clubs.
- d. Area power failure affecting heat.

INTRUSION DETECTION SYSTEMS

Code 1

- a. Finance, PX and Commissary, and high security areas.

Code 2

- a. Systems other than those listed under Code 1.

KITCHEN EQUIPMENT

Code 2

- a. All other equipment not listed under Code 1.

PLUMBING

Code 2

- a. Flush valves.
- b. Fixture drain, supply line commode, or water pipe leaking.
- c. Commode leaking at base.

ROOF LEAKS

Code 1

- a. Temporary repairs will be made where major damage to property is occurring.

Code 2

- a. Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

WATER (Exterior)

Code 1

- a. Normal operation of water pump station.

Code 2

- No water to facility.

WATER, HOT (and STEAM)

Code 1

- a. Hospitals.
- b. Mess Halls.
- c. BOQ. BEQ. barracks (entire building).
- d. Medical and dental.

Code 2

- a. No hot water in portion of building listed under Code 1 (items a through c).

SPRINKLER SYSTEM

Code 1

- a. All sprinkler systems, valves, manholes, deluge systems, and air systems to sprinkler

1.8.2 Availability of Required Parts

Should parts be required to complete the work and the parts are not immediately available the Contractor shall have a maximum of 12 hours after arrival at the job site to provide authorized representative of the installation with firm written plan for emergency alternatives and temporary repairs for Government participation with the Contractor to provide emergency relief until the required parts are available on site for

the Contractor to perform permanent warranty repair. The Contractors plan shall include a firm date and time that the required parts shall be available on site to complete the permanent warranty repair.

PART 2 PRODUCTS - NOT APPLICABLE

PART 3 EXECUTION - NOT APPLICABLE

-- End of Section --

## SECTION 01312A

## QUALITY CONTROL SYSTEM (QCS)

08/01

## PART 1 GENERAL

## 1.1 GENERAL

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

- Administration
- Finances
- Quality Control
- Submittal Monitoring
- Scheduling
- Import/Export of Data

## 1.1.1 Correspondence and Electronic Communications

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

## 1.1.2 Other Factors

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01320A, PROJECT SCHEDULE, Section 01330, SUBMITTAL PROCEDURES, and Section 01451A, CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

## 1.2 QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior

to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request by the Contractor, the Government can provide QCS on 3-1/2 inch high-density diskettes or CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become available.

### 1.3 SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS:

#### **Hardware**

IBM-compatible PC with 200 MHz Pentium or higher processor

32+ MB RAM

4 GB hard drive disk space for sole use by the QCS system

3 1/2 inch high-density floppy drive

Compact disk (CD) Reader

Color monitor

Laser printer compatible with HP LaserJet III or better, with minimum 4 MB installed memory.

Connection to the Internet, minimum 28 BPS

#### **Software**

MS Windows 95 or newer version operating system (MS Windows NT 4.0 or newer is recommended)

Word Processing software compatible with MS Word 97 or newer

Internet browser

The Contractor's computer system shall be protected by virus protection software that is regularly upgraded with all issued manufacturer's updates throughout the life of the contract.

Electronic mail (E-mail) compatible with MS Outlook

### 1.4 RELATED INFORMATION

#### 1.4.1 QCS User Guide

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website; the

Contractor can obtain the current address from the Government. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

#### 1.4.2 Contractor Quality Control(CQC) Training

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

#### 1.5 CONTRACT DATABASE

Prior to the pre-construction conference, the Government shall provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by files attached to E-mail. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

#### 1.6 DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. The Contractor shall establish and maintain the QCS database at the Contractor's site office. Data updates to the Government shall be submitted by E-mail with file attachments, e.g., daily reports, schedule updates, payment requests. If permitted by the Contracting Officer, a data diskette or CD-ROM may be used instead of E-mail (see Paragraph DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM). The QCS database typically shall include current data on the following items:

##### 1.6.1 Administration

###### 1.6.1.1 Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format via E-mail.

###### 1.6.1.2 Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format via E-mail.

###### 1.6.1.3 Correspondence

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home



(main) office shall be prefixed with "H". Letters shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

#### 1.6.1.4 Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

#### 1.6.1.5 Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

#### 1.6.1.6 EM 385-1-1, Corps of Engineers Safety Manual and QCS Linkage

Upon request, the Contractor can obtain a copy of the current version of the Safety Manual, EM 385-1-1, on CD or visit  
"<http://www.usace.army.mil/inet/usace-docs/ent-manuals/em385-1-1/entire.pdf>.  
Data on the CD will be accessible through QCS, or in stand-alone mode.

### 1.6.2 Finances

#### 1.6.2.1 Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

#### 1.6.2.2 Payment Requests

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet and include it with the payment request. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. The Contractor shall submit the payment requests with supporting data by E-mail with file attachment(s). If permitted by the Contracting Officer, a data diskette may be used instead of E-mail. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

#### 1.6.3 Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The

Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. The Contractor shall provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01451A, CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, the Contractor shall submit a data diskette or CD-ROM reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

#### 1.6.3.1 Daily Contractor Quality Control (CQC) Reports.

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by Section 01451A, CONTRACTOR QUALITY CONTROL. Reports shall be submitted electronically to the Government using E-mail or diskette within 24 hours after the date covered by the report. Use of either mode of submittal shall be coordinated with the Government representative. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report.

#### 1.6.3.2 Deficiency Tracking.

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

#### 1.6.3.3 Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

#### 1.6.3.4 Accident/Safety Tracking.

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 200.

#### 1.6.3.5 Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay

activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

#### 1.6.3.6 QC Requirements

The Contractor shall develop and maintain a complete list of QC testing, transferred and installed property, and user training requirements in QCS. The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

#### 1.6.4 Submittal Management

The Government will provide the initial submittal register, ENG Form 4288, SUBMITTAL REGISTER, in electronic format. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

#### 1.6.5 Schedule

The Contractor shall develop a construction schedule consisting of pay activities, in accordance with Contract Clause "Schedules for Construction Contracts", or Section 01320A, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01320A PROJECT SCHEDULE). The updated schedule data shall be included with each pay request submitted by the Contractor.

#### 1.6.6 Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data, and schedule data using SDEF.

### 1.7 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

### 1.8 DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of updates, payment requests, correspondence and other data is by E-mail with file attachment(s). For locations where this is not feasible, the Contracting

Officer may permit use of computer diskettes or CD-ROM for data transfer. Data on the disks or CDs shall be exported using the QCS built-in export function. If used, diskettes and CD-ROMs will be submitted in accordance with the following:

#### 1.8.1 File Medium

The Contractor shall submit required data on 3-1/2 inch double-sided high-density diskettes formatted to hold 1.44 MB of data, capable of running under Microsoft Windows 95 or newer. Alternatively, CD-ROMs may be used. They shall conform to industry standards used in the United States. All data shall be provided in English.

#### 1.8.2 Disk or CD-ROM Labels

The Contractor shall affix a permanent exterior label to each diskette and CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

#### 1.8.3 File Names

The Government will provide the file names to be used by the Contractor with the QCS software.

#### 1.9 MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions. The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

#### 1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

-- End of Section --

SECTION 01320

PROJECT SCHEDULE  
05/02

PART 1 GENERAL

1.1 REFERENCE

The publications listed below form a part of the specification to the extent referenced. The publications are referenced in the text by basic designation only.

ENGINEERING REGULATIONS (ER)

ER 1-1-11 (1995) Progress, Schedules, and Network  
Analysis Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Initial Project Schedule; G AR.

Shows sequence of activities for work through the entire project and shall be at a resonable level of detail.

Preliminary Project Schedule; G AR.

Payment Purpose.

Periodic Schedule Updates; G AR.

These updates enables the Contracting Officer assess Contractor's progress.

Qualifications; G AR.

Documentation showing qualifications of personnel preparing schedule reports.

Narrative Report; G AR. Schedule Reports; G AR.

Three copies of the reports showing numbers, descriptions, dates, float, starts, finishes, durations, sequences, etc., as required.

### 1.3 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports.

### PART 2 PRODUCTS (Not Applicable)

### PART 3 EXECUTION

#### 3.1 GENERAL REQUIREMENTS

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS, a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project shall also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments.

#### 3.2 BASIC FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel will result in an inability of the Contracting Officer to evaluate Contractor's progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, then the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

#### 3.3 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification. Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Contracting Officer.

Scheduling requirements shall conform to QCS Specification Section 1312A. These requirements include, but are not limited to the submittal register, categories of work and features of work codings. The Contractor's scheduling program must be compatible with QCS-W and importable into QCS-W. The website for QCS-W (Contractor's QC Module) is:  
<http://winrms.usace.army.mil/contractor's.htm>.

### 3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in the Precedence Diagram Method (PDM).

### 3.3.2 Level of Detail Required

The Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule.

#### 3.3.2.1 Activity Durations

Contractor submissions shall follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods (usually less than 2 percent of all non-procurement activities' Original Durations are greater than 20 days).

#### 3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, and delivery.

#### 3.3.2.3 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

#### 3.3.2.4 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, contractor work force, or government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

#### 3.3.2.5 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one

modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number. Whenever possible, changes shall be added to the schedule by adding new activities. Existing activities shall not normally be changed to reflect modifications.

#### 3.3.2.6 Bid Item

All activities shall be identified in the project schedule by the Bid Item to which the activity belongs. An activity shall not contain work in more than one bid item. the bid item for each appropriate activity shall be identified by the Bid Item Code.

#### 3.3.2.7 Category of Work

All Activities shall be identified in the project schedule according to the category of work which best describes the activity. Category of work refers, but is not limited, to the procurement chain of activities including such items as submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing. The category of work for each activity shall be identified by the Category of Work Code.

#### 3.3.2.8 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

#### 3.3.2.9 Specification Section

All activities shall be identified in the project schedule according to the specification section to which the activity belongs.

#### 3.3.3 Scheduled Project Completion

The schedule interval shall extend from Notice-to-Proceed to the contract completion date.

##### 3.3.3.1 Project Start Date

The schedule shall start no earlier than the date on which the Notice to Proceed (NTP) was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have: an "ES" constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

##### 3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. The Contractor shall include as the last activity in the project schedule an activity call "End Project". The "End Project"



activity shall have: an "LF" constraint date equal to the completion date for the project, and a zero day duration.

#### 3.3.3.3 Early Project Completion

In the event the project schedule shows completion of the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted in the narrative report at every project schedule update period to assist the Contracting Officer in evaluating the Contractor's ability to actually complete prior to the contract period.

#### 3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

#### 3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in-progress or completed activity and failure to ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Program features which calculate one of these parameters from the other shall be disabled.

#### 3.3.6 Out-of-Sequence Progress

Activities that have posted progress without all preceding logic being satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case approval of the Contracting Officer. The Contractor shall propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule.

#### 3.3.7 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

### 3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are

contained in paragraph SUBMISSION REQUIREMENTS.

#### 3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 20 calendar days after Notice to Proceed is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 60 calendar days after Notice to Proceed.

#### 3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 40 calendar days after Notice to Proceed. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

#### 3.4.3 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic schedule updates. These submissions shall enable the Contracting Officer or to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgement of the Contracting Officer or authorized representative, is necessary for verifying the contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

#### 3.4.4 Standard Activity Coding Dictionary

The Contractor shall use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used.

### 3.5 SUBMISSION REQUIREMENTS

The following items shall be submitted by the Contractor for the preliminary submission, and every periodic project schedule update throughout the life of the project:

#### 3.5.1 Data Disks

Two data disks containing the project schedule shall be provided. Data on the disks shall adhere to the SDEF format specified in ER 1-1-11, Appendix A.

##### 3.5.1.1 File Medium

Required data shall be submitted on 3.5 disks, formatted to hold 1.44 MB of data, on Micro Soft Windows 2000, unless otherwise approved by the Contracting Officer.

## 3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Initial, Update, or Change), full contract number, project name, project location, data date, name and telephone number or person responsible for the schedule, and the version used to format the disk.

## 3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will ensure that the names of the files submitted are unique. The Contractor shall submit the file naming convention to the Contracting Officer for approval.

## 3.5.2 Narrative Report

A Narrative Report shall be provided with the preliminary, initial, and each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to relay to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through that analysis.

## 3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

## 3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in progress or completed.

## 3.5.4.1 Activity Report

A list of all activities sorted according to activity number.

## 3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number. Preceding and succeeding activities shall include all information listed above in paragraph Schedule Reports.

A blank line shall be left between each activity grouping.

#### 3.5.4.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates. Completed activities shall not be shown on this report.

#### 3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the Notice to Proceed until the most recent Monthly Progress Meeting. This report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; and complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost) and Earnings to Date.

#### 3.5.5 Network Diagram

The network diagram shall be required on the initial schedule submission and on monthly schedule update submissions. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

##### 3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity number, description, duration, and estimated earned value shall be shown on the diagram.

##### 3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

##### 3.5.5.3 Critical Path

The critical path shall be clearly shown.

##### 3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work,

work area and/or responsibility.

#### 3.5.5.5 S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

### 3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly onsite meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor shall describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

#### 3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

#### 3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

#### 3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost-to-Date shall be subject to the approval of the Contracting Officer. As a minimum, the Contractor shall address the following items on an activity by activity basis, during each progress meeting.

##### 3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed.

##### 3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations must be based on Remaining Duration for each activity.

##### 3.6.3.3 Cost Completion

The earnings for each activity started. Payment will be based on earnings for each in-progress or completed activity. Payment for individual activities will not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

#### 3.6.3.4 Logic Changes

All logic changes pertaining to Notice to Proceed on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, lag durations, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

#### 3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule which does not represent the actual plan prosecution and progress of the work.

### 3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, or any interim milestone date, the Contractor shall furnish the following for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

#### 3.7.1 Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with this request.

The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, will not be a cause for a time extension to the contract completion date.

#### 3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under 2 weeks based upon the most recent schedule update at the time of the Notice to Proceed or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

- a. A list of affected activities, with their associated project schedule activity number.
- b. A brief explanation of the causes of the change.
- c. An analysis of the overall impact of the changes proposed.

- d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

#### 3.7.3 Additional Submission Requirements

For any requested time extension of over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

#### 3.8 DIRECTED CHANGES

If Notice to Proceed (NTP) is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, the Contractor shall advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

#### 3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

-- End of Section --

SECTION 01330

SUBMITTAL PROCEDURES  
05/02

PART 1 GENERAL

1.1 SUBMITTAL IDENTIFICATION (SD)

Submittals required are identified by SD numbers and titles as follows:

SD-01 Preconstruction Submittals

SD-02 Shop Drawings

SD-03 Product Data

SD-04 Samples

SD-05 Design Data

SD-06 Test Reports

SD-07 Certificates

SD-08 Manufacturer's Instructions

SD-09 Manufacturer's Field Reports

SD-10 Operation and Maintenance Data

SD-11 Closeout Submittals

1.2 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.2.1 Government Approved

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.2.2 Information Only

All submittals not requiring Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above. On Submittal Register, ENG FORM 4288, column labeled "Reviewer" is blank and is understood that the reviewer is "AR" (Area Office).



### 1.3 APPROVED SUBMITTALS

The Contracting Officer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

### 1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Contracting Officer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Contracting Officer.

### 1.5 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

### 1.6 GENERAL

The Contractor shall make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager and each item shall be stamped, signed, and dated by the CQC System Manager indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Government approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

## 1.7 SUBMITTAL REGISTER

At the end of this section is a submittal register showing items of equipment and materials for which submittals are required by the specifications; this list may not be all inclusive and additional submittals may be required. The Contractor shall maintain a submittal register for the project in accordance with Section 01312A QUALITY CONTROL SYSTEM (QCS).

## 1.8 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 30 calendar days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals.

## 1.9 TRANSMITTAL FORM (ENG FORM 4025)

The sample transmittal form (ENG Form 4025) attached to this section shall be used for submitting both Government approved and information only submittals in accordance with the instructions on the reverse side of the form. These forms are included in the QCS software that the Contractor is required to use for this contract. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

## 1.10 SUBMITTAL PROCEDURES

Six (6) copies of submittals shall be made as follows:

### 1.10.1 Procedures

In the signature block provided on ENG Form 4025 the Contractor certifies that each item has been reviewed in detail and is correct and is in strict conformance with the contract drawings and specifications unless noted otherwise. The accuracy and completeness of submittals is the responsibility of the Contractor. Any costs due to resubmittal of documents caused by inaccuracy, lack of coordination, and/or checking shall be the responsibility of the Contractor. This shall include the handling and review time on the part of the Government. Each variation from the contract specifications and drawings shall be noted on the form; and, attached to the form, the Contractor shall set forth, in writing, the reason for and description of such variations. If these requirements are not met, the submittal may be returned for corrective action.

### 1.10.2 Deviations

For submittals which include proposed deviations requested by the

Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

#### 1.11 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

#### 1.12 GOVERNMENT APPROVED SUBMITTALS

Upon completion of review of submittals requiring Government approval, the submittals will be identified as having received approval by being so stamped and dated. Four (4) copies of the submittal will be retained by the Contracting Officer and two (2) copies of the submittal will be returned to the Contractor.

#### 1.13 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

#### 1.14 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR
(Firm Name)
_____ Approved
_____ Approved with corrections as noted on submittal data and/or attached sheets(s).
SIGNATURE: _____
TITLE: _____
DATE: _____

## 1.15 CERTIFICATES OF COMPLIANCE: (MAY 1969)

Any Certificate required for demonstrating proof of compliance of materials with specification requirements shall be executed in four (4) copies. Each certificate shall be signed by an official authorized to certify in behalf on the manufacturing company and shall contain the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material, if, after tests are performed on selected samples, the material is found not to meet the specific requirements. (CENAB)

-- End of Section --

# SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Renovations to Conmy Hall

CONTRACTOR

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01000	SD-01 Preconstruction Submittals														
			Title Evidence		FIO												
			Invoice Copies		FIO												
			Photographs	1.12	FIO												
			SD-03 Product Data														
			Cost or Pricing Data	1.6	FIO												
			Equipment Data	1.7	FIO												
			SD-05 Design Data														
			Progress Schedule		G AR												
			SD-10 Operation and Maintenance Data														
			O and M Data	1.8	FIO												
			Commissioning Activity for HVAC	1.2.5	G AR												
		01050	SD-01 Preconstruction Submittals														
			Shut Down Utility Services	1.4.2	G AR												
			Checklist	1.4.3	G AR												
			Impact Submittals		G AR												
			SD-07 Certificates														
			Operations Statement	1.10.2	FIO												
		01060	SD-01 Preconstruction Submittals														
			Safety Supervisor	1.3	G AR												
			Activity Phase Hazard Analysis Plan	1.3	G AR												
			Outline Report		FIO												
			OSHA Log		FIO												
			SD-07 Certificates														

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		01060	Language Certification	1.3	FIO												
		01200	SD-04 Samples														
			Sample Tags	1.7.1.2	FIO												
		01320	SD-01 Preconstruction Submittals														
			Initial Project Schedule	3.4.2	G AR												
			Preliminary Project Schedule	3.4.1	G AR												
			Periodic Schedule Updates	3.4.3	G AR												
			Qualifications	1.3	G AR												
			Narrative Report	3.5.2	G AR												
			Schedule Reports	3.5.4	G AR												
		01451	SD-01 Preconstruction Submittals														
			CQC Plan	3.2	G AR												
			Phase Notification		FIO												
			Request		G AR												
			CQC Mgr Qualification		G AR												
			SD-02 Shop Drawings														
			Coordination Drawings		FIO												
			SD-05 Design Data														
			Notification of Changes	3.2.4	FIO												
			Punchlist	3.10.1	FIO												
			Minutes	3.3	FIO												
			SD-06 Test Reports														
			Tests	3.8.1	FIO												
			Documentation	3.11	FIO												
			Tests Performed	3.8.1	FIO												
			QC Records		G AR												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01452A	SD-07 Certificates														
			Special Inspector	1.3	G												
			Quality Assurance Plan	1.4	G A/												
		01510	SD-02 Shop Drawings														
			Temporary Electrical Work	1.7	G AR												
		01562	SD-01 Preconstruction Submittals														
			Implementation	1.5	G AR												
		01720	SD-11 Closeout Submittals														
			Progress Prints		G AR												
			Final Requirements	1.6	G AR												
			CADD Files		FIO												
		02300	SD-03 Product Data														
			Utilization of Excavated Materials	3.8	G A/												
			Rock Excavation		FIO												
			Opening of any Excavation or Borrow Pit		FIO												
			SD-06 Test Reports														
			Testing	3.15	FIO												
			Borrow Site Testing	2.1	FIO												
			SD-07 Certificates														
			Testing	3.15	FIO												
		02555A	SD-02 Shop Drawings														
			Distribution System	3.5.9	G												
			SD-03 Product Data														
			Distribution System	3.5.9	FIO												
			SD-07 Certificates														

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		02555A	Distribution System	3.5.9	FIO												
			Welding	1.6	G												
			SD-10 Operation and Maintenance Data														
			Distribution System	3.5.9	G												
		02722A	SD-03 Product Data														
			Plant, Equipment, and Tools	1.6	FIO												
			SD-06 Test Reports														
			Sieve Analysis: G Liquid Limit and Plasticity Index: G Moisture Determination: G		FIO												
		02742A	SD-07 Certificates														
			Bituminous Material	2.1.1	FIO												
		02821A	SD-07 Certificates														
			Chain Link Fence	2.1.1	G A/												
		03100A	SD-02 Shop Drawings														
			Formwork	3.1.1	FIO												
			SD-03 Product Data														
			Design	1.3	FIO												
			Form Materials	2.1	FIO												
			Form Releasing Agents	2.1.6	FIO												
			SD-04 Samples														
			Fiber Voids	2.1.7	G A/												
			SD-07 Certificates														
			Fiber Voids	2.1.7	FIO												
		03150A	SD-02 Shop Drawings														



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		03150A	Waterstops	2.4	G A/												
			SD-03 Product Data														
			Preformed Expansion Joint Filler	2.2	FIO												
			Sealant	2.3	FIO												
			Waterstops	2.4	FIO												
			SD-04 Samples														
			Non-metallic Materials	2.4.3	FIO												
			SD-07 Certificates														
			Preformed Expansion Joint Filler	2.2	FIO												
			Sealant	2.3	FIO												
			Waterstops	2.4	FIO												
		03200A	SD-02 Shop Drawings														
			Reinforcement	3.1	G A/												
			SD-03 Product Data														
			Welding	1.3	FIO												
			SD-07 Certificates														
			Reinforcing Steel	2.3	FIO												
		03300A	SD-03 Product Data														
			Mixture Proportions	1.7	G A/												
			SD-04 Samples														
			Surface Retarder	2.3.5	G A/												
			SD-06 Test Reports														
			Testing and Inspection for Contractor Quality Control	3.14	G A/												
			SD-07 Certificates														
			Qualifications	1.4	G A/												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		04200	SD-02 Shop Drawings														
			Structural Masonry	1.5	G												
			A/E		FIO												
			SD-03 Product Data														
			Clay or Shale Brick	2.2	G												
			A/E		FIO												
			Flashing	2.14	G												
			Water-Repellant Admixture	2.7	G												
			Cold Weather Installation	3.1.2	G												
			SD-04 Samples														
			Concrete Masonry Units (CMU)	2.3	G												
			A/E		FIO												
			Clay or Shale Brick	2.2	G												
			Anchors, Ties, and Bar Positioners	2.9	G												
			Expansion-Joint Materials	2.13	G												
			Joint Reinforcement	2.10	G												
			Portable Panel	1.3	G												
			SD-05 Design Data														
			Pre-mixed Mortar	2.6.5	G												
			A/E		FIO												
			Unit Strength Method	1.5.2	G												
			SD-06 Test Reports														
			Efflorescence Test	3.17.3	G												
			A/E		FIO												
			Field Testing of Mortar	3.17.1	G												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		04200	Field Testing of Grout	3.17.2	G												
			Prism tests	3.17.4	G												
			Masonry Cement	2.6.4	G												
			Special Inspection	1.5.1	G												
			SD-07 Certificates														
			Clay or Shale Brick	2.2	FIO												
			Concrete Masonry Units (CMU)	2.3	FIO												
			Control Joint Keys	2.12	FIO												
			Anchors, Ties, and Bar	2.9	FIO												
			Positioners														
			Expansion-Joint Materials	2.13	FIO												
			Joint Reinforcement	2.10	FIO												
			Reinforcing Steel Bars and Rods	2.11	FIO												
			Masonry Cement	2.6.4	FIO												
			Admixtures for Masonry Mortar	2.6.1	FIO												
			Admixtures for Grout	2.8.1	FIO												
			SD-08 Manufacturer's Instructions														
			Masonry Cement	2.6.4	FIO												
		04900	SD-02 Shop Drawings														
			Masonry	1.6	G AE												
			SD-03 Product Data														
			Cleaning and Restoration	1.3.1	G AE												
			Methods														
			Qualifications	1.4	FIO												
			SD-04 Samples														
			Materials	2.1	FIO												

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		04900	Sample Masonry Panels	1.6	G AE												
			SD-07 Certificates														
			Materials	2.1	FIO												
		05090A	SD-03 Product Data														
			Welding Procedure Qualifications	1.5	G A/												
			Welder, Welding Operator, and	1.6	FIO												
			Tacker Qualification														
			Inspector Qualification	1.7	FIO												
			Previous Qualifications	1.5.1	FIO												
			Prequalified Procedures	1.5.2	FIO												
			SD-06 Test Reports														
			Quality Control	3.2	FIO												
		05500A	SD-02 Shop Drawings														
			Miscellaneous Metal Items	1.6	FIO												
			Miscellaneous Metal Items	1.6	FIO												
			S-04 Samples		FIO												
		06100A	SD-07 Certificates														
			Grading and Marking	2.1.1	FIO												
					07												
			Insulation		FIO												
		06200A	SD-02 Shop Drawings														
			Finish Carpentry		G AE												
			SD-03 Product Data														
			Wood Items, Siding, and Trim	2.1	FIO												
					03												
			SD-04 Samples														

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		06200A	Siding	2.1.5	G AE												
			Moldings		G AE												
			Fascias and Trim		G AE												
		06410A	SD-02 Shop Drawings														
			Shop Drawings	1.7	G												
			AE		FIO												
			Installation	3.1	G												
			SD-03 Product Data														
			Wood Materials	2.1	G												
			AE		FIO												
			Wood Finishes	2.8	G												
			Finish Schedule	2.9.8.3	G												
			SD-04 Samples														
			Plastic Laminates	2.2	G												
			AE		FIO												
			Veneer-Faced Panel Products		G AE												
			SD-07 Certificates														
			Quality Assurance	1.4	FIO												
			Laminate Clad Casework	2.8	FIO												
			Laminate Clad Casework	3.1	FIO												
		06650	SD-02 Shop Drawings														
			Shop Drawings		G AE												
			SD-03 Product Data														
			Solid polymer material	2.1	FIO												
			Qualifications	1.6	FIO												
			Fabrications	2.3	FIO												

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		06650	SD-04 Samples														
			Material	2.1	G AE												
			SD-06 Test Reports														
			Solid polymer material	2.1	FIO												
			SD-07 Certificates														
			Fabrications	2.3	FIO												
			Qualifications	1.6	FIO												
			SD-10 Operation and Maintenance														
			Data														
			Clean-up	3.3	FIO												
		07110A	SD-07 Certificates														
			Materials	1.4	FIO												
		07212N	SD-03 Product Data														
			Blanket insulation	2.1	FIO												
			Sill sealer insulation		FIO												
			Vapor retarder		FIO												
			Pressure sensitive tape		FIO												
			Accessories	2.3	FIO												
			SD-08 Manufacturer's Instructions														
			Insulation	3.3.1	FIO												
		07311	SD-03 Product Data														
			Shingles	2.1.1	FIO												
			SD-04 Samples														
			Shingles	2.1.1	G AE												
			Color charts	2.1.1	G AE												
			SD-08 Manufacturer's Instructions														

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		07311	Application	3.3	FIO												
		07551A	SD-03 Product Data														
			EVT and Flash Point	3.6	FIO												
			Materials		G AE												
			Installation	3.9	G AE												
			SD-07 Certificates														
			Manufacturer	1.2	FIO												
			Materials		FIO												
		07600	SD-02 Shop Drawings														
			Covering on flat, sloped, or curved surfaces	3.1.17	G												
			AE		FIO												
			Gutters	3.1.15	G												
			Downspouts	3.1.16	G												
			Gravel stops and fascias	3.1.13	G												
			Base flashing		G												
			Counterflashing	3.1.10	G												
			Flashing at roof penetrations	3.1.18	G												
			Reglets	3.1.11	G												
			Drip edge	3.1.14	G												
			Eave flashing		G												
			SD-11 Closeout Submittals														
			Quality Control Plan		FIO												
		07840	SD-02 Shop Drawings														
			Firestopping Materials	2.1	G AE												
			SD-07 Certificates														

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		07840	Firestopping Materials	2.1	FIO												
			Installer Qualifications	1.5	FIO												
			Inspection	3.3	FIO												
		07920	SD-03 Product Data														
			Sealants	2.1	FIO												
			Acoustical Sealants		FIO												
			Sheet Caulking		FIO												
			Primers	2.2	FIO												
			Bond breakers	2.3	FIO												
			Backstops	2.4	FIO												
			SD-07 Certificates														
			Sealant	3.3.6	FIO												
		08110	SD-02 Shop Drawings														
			Doors	2.1	G												
			AE		FIO												
			Frames	2.5	G												
		08165A	SD-02 Shop Drawings														
			Sliding Metal Doors	1.6	G AE												
		08210	SD-02 Shop Drawings														
			Doors	2.1	G												
			AE		FIO												
			SD-03 Product Data														
			Doors	2.1	G												
			Accessories	2.2	FIO												
			Water-resistant sealer	2.3.7	FIO												
			warranty	1.4	FIO												



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		08210	Fire resistance rating	2.1.3	G												
			SD-04 Samples														
			Doors	2.1	FIO												
			AE		FIO												
			SD-06 Test Reports														
			Split resistance	2.4	FIO												
			Cycle-slam	2.4	FIO												
			Hinge loading resistance	2.4	FIO												
		08520A	SD-02 Shop Drawings														
			Aluminum Windows		G AE												
			SD-03 Product Data														
			Aluminum Windows		FIO												
			SD-04 Samples														
			Aluminum Windows		G AE												
			SD-06 Test Reports														
			Aluminum Windows		FIO												
			SD-07 Certificates														
			Aluminum Windows		FIO												
		08710	SD-02 Shop Drawings														
			Hardware schedule	1.3	G												
			AE		FIO												
			Keying system	2.3.7	FIO												
			SD-03 Product Data														
			Hardware items	2.3	G												
			AE		FIO												
			SD-08 Manufacturer's Instructions														

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		08710	Installation	3.1	FIO												
			SD-10 Operation and Maintenance Data														
			Hardware Schedule	1.3	G												
			AE		FIO												
			SD-11 Closeout Submittals														
			Key biting	1.4	FIO												
		08800	SD-02 Shop Drawings														
			Installation		G AE												
			SD-03 Product Data														
			Insulating Glass	1.6.1	FIO												
			Glazing Accessories	1.3	FIO												
			SD-04 Samples														
			Spandrel Glass;		G AE												
			Insulating Glass	1.6.1	FIO												
			Glazing Compound		FIO												
			Tape	2.3.2	FIO												
			Sealant	2.3.1.1	FIO												
			SD-07 Certificates														
			Insulating Glass	1.6.1	FIO												
			SD-08 Manufacturer's Instructions														
			Setting and sealing materials	2.3	FIO												
			Glass setting	3.2	FIO												
		09100N	SD-02 Shop Drawings														
			Metal support systems	2.1	G												
			AE		G												

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		09100N	SD-03 Product Data														
			AE		FIO												
		09250	SD-03 Product Data														
			Glass Mat Water-Resistant	2.1.4	FIO												
			Gypsum Tile Backing Board														
			Water-Resistant Gypsum Backing Board	2.1.3	FIO												
			Accessories	2.1.8	FIO												
			SD-07 Certificates														
			Asbestos Free Materials	2.1	FIO												
		09310	SD-03 Product Data														
			Tile	2.1	G AE												
			Setting-Bed	2.2	G AE												
			Mortar, Grout, and Adhesive	2.4	G AE												
			SD-04 Samples														
			Tile	2.1	G AE												
			Accessories		G AE												
			Slate Thresholds	2.5	G AE												
			SD-07 Certificates														
			Tile	2.1	FIO												
			Mortar, Grout, and Adhesive	2.4	FIO												
		09421A	SD-02 Shop Drawings														
			Terrazzo Base		G AE												
			SD-03 Product Data														
			Installation	3.3	FIO												
			SD-04 Samples														

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		09421A	Terrazzo Base		G AE												
			SD-07 Certificates														
			Terrazzo BAs		FIO												
			Adhesive	2.2	FIO												
			SD-10 Operation and Maintenance Data														
			Terrazzo Base		FIO												
		09445A	SD-02 Shop Drawings														
			Approved Detail Drawings	1.3	G AE												
			Strips	2.5	G AE												
			Conrol Joint Strips		G AE												
			SD-03 Product Data														
			Resin	2.2	FIO												
			Mixing, Proportioning, and Installation	3.2	FIO												
					03												
			Cleaning and Sealing	3.3	FIO												
			SD-04 Samples														
			Resinous Terrazzo Flooring	1.3	G AE												
		09510	SD-02 Shop Drawings														
			Approved Detail Drawings	1.3	FIO												
			AE,		FIO												
			SD-03 Product Data														
			Acoustical Ceiling Systems		FIO												
			AE,		FIO												
			SD-04 Samples														

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		09510	Acoustical Units	2.1	G AE												
			SD-07 Certificates														
			Acoustical Units	2.1	FIO												
		09620A	SD-02 Shop Drawings														
			Approved Detail Drawings		G AE												
			SD-03 Product Data														
			Installation	3.3	FIO												
					03												
			SD-04 Samples														
			Flooring	1.3	G AE												
			SD-07 Certificates														
			Materials	1.4	FIO												
					07												
		09650	SD-03 Product Data														
			Resilient Flooring and	2.9	FIO												
			Accessories														
			Adhesives	2.5	FIO												
			SD-04 Samples														
			Resilient Flooring and	2.9	G AE												
			Accessories														
			SD-06 Test Reports														
			Moisture, Alkalinity and Bond	3.3	FIO												
			Tests														
			SD-08 Manufacturer's Instructions														
			Surface Preparation	3.2	FIO												
			Installation	3.1	FIO												

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		09650	SD-10 Operation and Maintenance														
			Data														
			Resilient Flooring and Accessories	2.9	FIO												
		09680	SD-02 Shop Drawings														
			Installation	3.4	G AE												
			Molding		G AE												
			SD-03 Product Data														
			Carpet	2.1	FIO												
			Surface Preparation	3.1	FIO												
			Installation	3.4	FIO												
			Regulatory Requirements	1.3	FIO												
			SD-04 Samples														
			Carpet	2.1	G AE												
			Molding		G AE												
			SD-06 Test Reports														
			Moisture and Alkalinity Tests	3.2	FIO												
			SD-07 Certificates														
			Carpet	2.1	FIO												
			Regulatory Requirements	1.3	FIO												
			SD-10 Operation and Maintenance														
			Data														
			Carpet	2.1	FIO												
			Cleaning and Protection	3.5	FIO												
		09840A	SD-02 Shop Drawings														
			Approved Detail Drawings	2.1	G AE												

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		09840A	SD-03 Product Data														
			Installation	3.2	FIO												
			Acoustical Wall Panels	2.1	FIO												
			SD-04 Samples														
			Acoustical Wall Panels	2.1	G AE												
			SD-07 Certificates														
			Acoustical Wall Panels	2.1	FIO												
		09900	SD-02 Shop Drawings														
			Piping identification		FIO												
			stencil		FIO												
			SD-03 Product Data														
			Coating	2.1	G												
			Manufacturer's Technical Data	2.1	FIO												
			Sheets														
			SD-04 Samples														
			Color	1.8	G												
			SD-07 Certificates														
			Applicator's qualifications	1.3	FIO												
			Qualification Testing		G												
			SD-08 Manufacturer's Instructions														
			Application instructions	3.2.1	FIO												
			Mixing	3.6.2	FIO												
			Manufacturer's Material Safety	1.6.2	FIO												
			Data Sheets														
			SD-10 Operation and Maintenance														
			Data														

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		09900	Coatings:	2.1	G												
		10153	SD-02 Shop Drawings														
			Installation	3.1	G AE												
			SD-03 Product Data														
			Toilet Partition System	1.3	FIO												
			SD-04 Samples														
			Colors and Finishes	2.4	FIO												
		10201N	SD-02 Shop Drawings														
			Wall louvers	2.2	FIO												
			SD-04 Samples														
			Wall louvers	2.2	G AE												
			Door louvers		G AE												
		10430	SD-02 Shop Drawings														
			Approved Detail Drawings	3.1	G AE												
			SD-03 Product Data														
			Modular Exterior Signage System		FIO												
			Installation	3.1	FIO												
			Wind Load Requirements	1.4	FIO												
			SD-04 Samples														
			Exterior Signage	1.3	G AE												
		10440	SD-02 Shop Drawings														
			Detail Drawings	3.1	G AE												
			SD-03 Product Data														
			Installation	3.1	G AE												
			SD-04 Samples														
			Interior Signage	1.3	G												



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CONTRACTOR:  
SCHEDULE DATES

APPROVING AUTHORITY

DATE RCD  
FRM APPR  
AUTH

REMARKS

ACTIVITY NO

TRANSMITTAL NO

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DESCRIPTION	ITEM SUBMITTED

PARAGRAPH #

GOVT OR A/E REVIEW

SUBMIT

APPROVAL  
NEEDED  
BY

MATERIAL  
NEEDED  
BY

ACTION CODE

DATE  
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REMARKS

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CONTRACT NO.

## Renovations to Conmy Hall

CONTRACTOR:  
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# SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Renovations to Conmy Hall

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A C T I V I T Y  N O	T R A N S M I T T A L  N O	S P E C  S E C T	DESCRIPTION	P A R A G #  P H	C L A S S I F I C A T I O N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/  DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/  DATE RCD FRM APPR	REMARKS	
							APPROVAL NEEDED	MATERIAL NEEDED	A C T I O N  C O D E	DATE OF ACTION			DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	A C T I O N  C O D E			DATE OF ACTION
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	
		12490A	SD-02 Shop Drawings															
			Approved Detail Drawings	3.2	G AE													
			SD-03 Product Data															
			Window Treatments	3.2	G AE													
			Hardware	1.3	G AE													
			SD-04 Samples															
			Window Treatments	3.2	G AE													
		13080	SD-02 Shop Drawings															
			Bracing	3.1	G A/													
			Resilient Vibration Isolation	3.4	G A/													
			Devices															
			Equipment Requirements	1.4	G													
			SD-03 Product Data															
			Bracing	3.1	G A/													
			Equipment Requirements	1.4	G A/													
		13280A	SD-03 Product Data															
			Respiratory Protection Program	1.12	G													
			Cleanup and Disposal	3.11	G													
			Detailed Drawings		G													
			Materials and Equipment		FIO													
			Qualifications	1.5	G													
			Training Program	1.11	FIO													
			Medical Requirements	1.10	FIO													
			Encapsulants	2.1	G													
			SD-06 Test Reports															

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CONTRACT NO.

TITLE AND LOCATION Renovations to Conmy Hall						CONTRACTOR											
A C T I V I T Y  N O	T R A N S M I T T A L  N O	S P E C  S E C T	DESCRIPTION	P A R A G R A P H	G O V T  C L A S S I F I C A T I O N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY			MAILED TO CONTR/	REMARKS	
						SUBMIT (g)	BY (h)	BY (i)	A C T I O N  C O D E	DATE OF ACTION (k)		DATE RCD FROM CONTR (l)	DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)			A C T I O N  C O D E
(a)	(b)	(c)	ITEM SUBMITTED (d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		13280A	Exposure Assessment and Air Monitoring	3.9	G												
			Local Exhaust Ventilation	1.20	FIO												
			Licenses, Permits and Notifications	1.14	G												
			SD-07 Certificates														
			Vacuum, Filtration and Ventilation Equipment		FIO												
		13283N	SD-03 Product Data														
			Vacuum Filters	1.6.4	G												
			Respirators	1.6.1	G												
			SD-06 Test Reports														
			sampling results	1.5.2.3	G												
			Occupational and Environmental Assessment Data Report	1.5.2.3	G												
			SD-07 Certificates														
			Qualifications of CP	1.5.1.1	G												
			Testing Laboratory	1.5.1.3	G												
			Occupant Notification	3.1.1.1	G												
			Training Certification	1.5.1.2	G												
			Notification of the	3.1.1.1	G												
			Commencement of LBP Hazard Abatement														
			Third Party Consultant	1.5.1.4	G												
			Qualifications														

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A C T I V I T Y  N O	T R A N S M I T T A L  N O	S P E C  S E C T	DESCRIPTION	P A R A G R A P H	G O V T  C L A S S I F I C A T I O N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				MAILED TO CONTR/  DATE RCD FRM APPR	REMARKS	
						SUBMIT (g)	BY (h)	MATERIAL NEEDED (i)	A C T I O N  C O D E  (j)	DATE OF ACTION (k)	DATE RCD FROM CONTR (l)	DATE FWD TO APPR AUTH/ (m)	DATE RCD FROM OTH REVIEWER (n)	A C T I O N  C O D E  (o)			DATE OF ACTION (p)
		13283N	lead-based paint/paint with lead removal/control plan	1.5.3	G												
			Rental equipment notification	1.6.3	G												
			Respiratory Protection Program	1.5.2.6	G												
			Hazard Communication Program	1.5.2.7	G												
			EPA or Commonwealth of Virginia approved hazardous waste treatment, storage, or disposal facility		G												
			Lead Waste Management Plan	1.5.2.8	G												
			Vacuum filters	1.6.4	G												
			Clearance Certification	3.5.1.1	G												
			SD-11 Closeout Submittals														
			hazardous waste manifest	3.5.2.1	G												
			Medical Examinations	1.5.2.4	G												
			Training Certification	1.5.1.2	G												
			turn-in documents or weight tickets		G												
		13286N	SD-07 Certificates														
			Qualifications of CIH	1.8.1	G												
			Training Certification	1.8.1	G												
			PCB and Lamp Removal Work Plan	1.8.2	G												
			PCB and Lamp Disposal Plan	1.8.3	G												
			SD-11 Closeout Submittals														
			Transporter certification	3.5.2	G												

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		13286N	Certification of Decontamination	3.2.4	FIO												
			Certificate of Disposal and/or recycling	3.5.2.1	FIO												
			DD Form 1348-1		FIO												
			Testing results	3.3.1	FIO												
		13721A	SD-03 Product Data														
			Intrusion Detection System		G												
			Key Control Plan		G												
			Spare Parts		FIO												
			Manufacturer's Instructions	3.1	G												
			Testing	1.4	G												
			Experience	1.7	FIO												
			SD-06 Test Reports														
			Performance Verification Test	3.3.3	FIO												
			Materials and Equipment	2.1.1	FIO												
		13851A	SD-02 Shop Drawings														
			Fire Alarm Reporting System	1.4.1	FIO												
			SD-03 Product Data														
			Storage Batteries	2.2	FIO												
			Voltage Drop		FIO												
			Special Tools and Spare Parts	2.7.4	FIO												
			Technical Data and Computer Software	1.5	G												
			Training	3.5	FIO												
			Testing	3.4	FIO												
			SD-06 Test Reports														



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A C T I V I T Y  N O	T R A N S M I T T A L  N O	S P E C  S E C T	DESCRIPTION	P A R A G R A P H	C L A S S I F I C A T I O N /	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/  DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/  DATE RCD FRM APPR	
									A C T I O N  C O D E	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	A C T I O N  C O D E	DATE OF ACTION		
(a)	(b)	(c)	ITEM SUBMITTED (d)	(e)	(f)	SUBMIT (g)	BY (h)	BY (i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	REMARKS (r)
		13851A	Testing	3.4	FIO												
			SD-07 Certificates														
			Equipment		FIO												
			Qualifications	1.3.7	FIO												
			SD-10 Operation and Maintenance														
			Data														
			Technical Data and Computer	1.5	FIO												
			Software														
		13920A	SD-02 Shop Drawings														
			Installation Requirements	3.3	G												
			As-Built Drawings		G												
			SD-03 Product Data														
			Fire Pump Installation Related	3.1	G												
			Submittals														
			Installation Requirements	3.3	G												
			Spare Parts		FIO												
			Preliminary Test	3.8.2	G												
			System Diagrams		G												
			Fire Protection Specialist	1.8	G												
			Manufacturer's Representative	1.9	G												
			Field Training	3.10	G												
			Final Acceptance Test	3.8.3	G												
			SD-06 Test Reports														
			Preliminary Test	3.8.2	G												
			Final Acceptance Test	3.8.3	G												
			SD-07 Certificates														

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A C T I V I T Y  N O	T R A N S M I T T A L  N O	S P E C T  S E C T	DESCRIPTION	P A R A G R A P H	G O V T  C L A S S I F I C A T I O N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				MAILED TO CONTR/  DATE RCD FRM APPR	REMARKS	
						SUBMIT (g)	BY (h)	BY (i)	A C T I O N  C O D E	DATE OF ACTION (k)	DATE RCD FROM CONTR (l)	DATE FWD TO APPR AUTH/ (m)	DATE RCD FROM OTH REVIEWER (n)	A C T I O N  C O D E			DATE OF ACTION (p)
(a)	(b)	(c)	ITEM SUBMITTED (d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		13920A	Fire Protection Specialist	1.8	G												
			SD-10 Operation and Maintenance Data														
			Fire Pumps	3.8.2	FIO												
		13930A	SD-02 Shop Drawings														
			Shop Drawings	1.12	G												
			As-Built Drawings	3.11	G												
			SD-03 Product Data														
			Fire Protection Related Submittals	3.1	FIO												
			Sway Bracing	3.4.1	G												
			Materials and Equipment	2.3	G												
			Hydraulic Calculations	1.7	G												
			Spare Parts	1.11	G												
			Preliminary Tests	3.10	G												
			Final Acceptance Test	3.11	G												
			On-site Training	3.12	G												
			Fire Protection Specialist	1.8	G												
			Sprinkler System Installer	1.9	G												
			SD-06 Test Reports														
			Preliminary Test Report	3.11	G												
			Final Acceptance Test Report	3.11	G												
			SD-07 Certificates														
			Inspection by Fire Protection Specialist	3.3	G												

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION	PARAGRAPH	GLASS / FICARVIEW OR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS	
						SUBMIT	APPROVAL NEEDED	MATERIAL NEEDED	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER			ACTION CODE
(a)	(b)	(c)	ITEM SUBMITTED (d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		13930A	SD-10 Operation and Maintenance Data														
			Operating and Maintenance Instructions	3.12	FIO												
		15070A	SD-02 Shop Drawings														
			Coupling and Bracing	3.1	FIO												
			Flexible Couplings or Joints	3.3	FIO												
			Equipment Requirements	1.3	FIO												
			Contractor Designed Bracing	1.2.4	G												
			SD-03 Product Data														
			Coupling and Bracing	3.1	G												
			Equipment Requirements	1.3	G												
			Contractor Designed Bracing	1.2.4	G												
			SD-07 Certificates														
			Flexible Ball Joints	2.2	FIO												
		15080A	SD-02 Shop Drawings														
			Mica Plates	3.2.2.4	FIO												
			SD-03 Product Data														
			General Materials	2.1	FIO												
			SD-04 Samples														
			Thermal Insulation Materials		G												
		15181A	SD-02 Shop Drawings														
			Piping System	2.4	FIO												
			SD-03 Product Data														
			Materials and Equipment	2.1	G												
			Water Treatment Systems	2.12	G												

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION	PARAGRAPH	CLASS / E S I F I C A T I O N S I F I C A R E V I O N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/  DATE RCD FRM APPR AUTH	REMARKS		
						SUBMIT	APPROVAL NEEDED	BY	MATERIAL NEEDED	ACTION CODE		DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER			ACTION CODE	DATE OF ACTION
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)		
		15181A	Spare Parts	1.6.3	FIO														
			Qualifications	1.3	G														
			Field Tests	3.3	FIO														
			Demonstrations	3.4	FIO														
			Verification of Dimensions	1.6.1	FIO														
			SD-06 Test Reports																
			Field Tests	3.3	FIO														
			One-Year Inspection	3.5	FIO														
			SD-07 Certificates																
			Service Organization	2.1	FIO														
			SD-10 Operation and Maintenance Data																
			Operation Manuals	3.4	FIO														
			Maintenance Manuals	3.4	FIO														
			Water Treatment Systems	2.12	FIO														
		15185N	SD-02 Shop Drawings																
			Hot water heating system	1.3.1	FIO														
			SD-03 Product Data																
			Convectors	2.4.2	FIO														
			Finned tube radiators	2.4.1	FIO														
			Pumps	2.3.1	FIO														
			Expansion tanks	2.3.2	FIO														
			Flow measuring equipment	2.3.5	FIO														
			Backflow preventers	2.3.4	FIO														
			External air separation tanks	2.3.3	FIO														
			Hot water heating pipe	2.1.1	FIO														

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A C T I V I T Y  N O	T R A N S M I T T A L  N O	S P E C  S E C T	DESCRIPTION	P A R A G R A P H	G O V T  C L A S S I F I C A T I O N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		APPROVING AUTHORITY				MAILED TO CONTR/  DATE RCD FRM APPR	REMARKS	
						SUBMIT (g)	BY (h)	MATERIAL NEEDED (i)	A C T I O N  C O D E  (j)	DATE OF ACTION (k)	DATE FWD TO APPR AUTH/ FROM CONTR (l)	DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)	A C T I O N  C O D E  (o)			DATE OF ACTION (p)
(a)	(b)	(c)	ITEM SUBMITTED (d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		15185N	SD-06 Test Reports														
			Hydrostatic test of piping system	3.3.1	FIO												
			Auxiliary equipment and accessory tests	3.3.2	FIO												
			SD-07 Certificates														
			Backflow preventer certification	1.5.4	FIO												
			Report of prior installations	1.5.2.1	FIO												
			Welding procedures	1.5.2.2	FIO												
			Welder's qualifications	1.5.2.3	FIO												
			SD-10 Operation and Maintenance Data														
			Convectors	2.4.2	G												
			Finned tube radiators	2.4.1	G												
		15216N	SD-02 Shop Drawings														
			Welding pressure piping	1.5.1	FIO												
			SD-07 Certificates														
			Welding procedures qualification	1.5.3	FIO												
			Nondestructive examination (NDE) procedures	1.5.2	FIO												
			NDE personnel certification procedures	1.5.6.2	FIO												
			Inspector certification	1.5.6.1	FIO												
			SD-11 Closeout Submittals														
			Weld identifications	1.5.7.1	FIO												
		15400A	SD-02 Shop Drawings														
			Plumbing System	3.8.1	G												

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Renovations to Conmy Hall																	
ACTIVITY NO	TRANSMITTAL NO	SPEC	DESCRIPTION	PARAGRAPH	GOVT CLASS / FIC REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY			DATE OF ACTION	DATE RCD FRM APPR	REMARKS
						SUBMIT (g)	BY (h)	MATERIAL NEEDED (i)	ACTION (j)	DATE OF ACTION (k)		DATE RCD FROM CONTR (l)	DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTHER REVIEWER (n)			
		15400A	Electrical Work	1.4	G												
			SD-03 Product Data														
			Plumbing Fixture Schedule	3.9	FIO												
			Vibration-Absorbing Features	3.4	G												
			Plumbing System	3.8.1	FIO												
			SD-06 Test Reports														
			Tests, Flushing and Disinfection	3.8	FIO												
			Test of Backflow Prevention Assemblies	3.8.1.1	G												
			SD-07 Certificates														
			Materials and Equipment	1.3	FIO												
			Bolts	2.1.1	FIO												
			SD-10 Operation and Maintenance Data														
			Plumbing System	3.8.1	G												
		15601N	SD-02 Shop Drawings														
			Air-cooled condensers, remote-type		G												
			SD-03 Product Data														
			Water chillers	2.1	G												
			Electric motors and starters	2.1.1.9	G												
			SD-06 Test Reports														
			Pressure vessel tests	1.4.2	G												
			Salt-spray tests	2.3.1	G												
			Make-up water analysis	1.4.2	G												

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(a)	(b)	(c)	ITEM SUBMITTED (d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		15601N	Start-up and initial operational tests	3.5.1	G												
			Water analysis		G												
			Field-assembled cooling towers		G												
			SD-08 Manufacturer's Instructions														
			Central refrigeration equipment	1.5	G												
			Chemicals		G												
			SD-10 Operation and Maintenance Data														
			Water Chillers	2.1	G												
			Electric motors and starters	2.1.1.9	G												
		15720N	SD-03 Product Data														
			Central station air handlers	2.2	FIO												
			Fans	2.1	FIO												
			Fan-coil units	2.3	FIO												
			Filter Sections	2.2.5	FIO												
			Eliminators	2.2.8.2	FIO												
			Drip Pans	2.2.8.3	FIO												
			Humidifiers	2.2.9	FIO												
			Custom Air Handling Units		FIO												
			Manometers	2.2.5	FIO												
			SD-06 Test Reports														
			Corrosion protection	1.4	FIO												
			Preliminary tests	3.3.2	FIO												
			Air handling and distribution equipment tests	3.3.3	FIO												

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	A C T I O N  C O D E	DATE OF A C T I O N		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	A C T I O N  C O D E	DATE OF A C T I O N		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		15720N	Dampers	2.2.2	FIO												
			SD-07 Certificates														
			Central station air handlers	2.2	FIO												
			Fans	2.1	FIO												
			Fan-coil units	2.3	FIO												
			SD-10 Operation and Maintenance														
			Data														
			Central station air handlers	2.2	FIO												
			Fans	2.1	FIO												
			Fan-coil units	2.3	FIO												
			Custom Air Handling Units		FIO												
			Filter sections	2.2.5	FIO												
			Humidifiers	2.2.9	FIO												
		15810N	SD-01 Preconstruction Submittals														
			Diffusers, registers, and grilles	2.5	FIO												
			SD-02 Shop Drawings														
			test holes		FIO												
			SD-03 Product Data														
			Dampers	2.9	FIO												
			Fire dampers	2.9.3	FIO												
			Automatic Smoke-Fire Dampers	2.9.4	FIO												
			Automatic smoke dampers	2.9.5	FIO												
			Sound attenuators		FIO												
			Acoustical duct lining	2.2.4.1	FIO												
			Flexible ducts and connectors	2.3	FIO												
			Insulation and vapor barrier	2.3.2	FIO												



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						SUBMIT (g)	BY (h)	MATERIAL NEEDED (i)	A C T I O N  C O D E  (j)	DATE OF ACTION (k)		DATE RCD FROM CONTR (l)	DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)			A C T I O N  C O D E  (o)
	15810N		Duct-liner adhesives	2.1.5	FIO												
			Louvers	2.9	FIO												
			Louvered penthouse		FIO												
			Bird screens	2.9.7.1	FIO												
			Diffusers, registers, and grilles	2.5	FIO												
			Troffers		FIO												
			Metal ducts	2.1	FIO												
			Test holes		FIO												
			Sound-attenuator ducts		FIO												
			SD-05 Design Data														
			Duct span versus reinforcement schedule	1.4.1	FIO												
			SD-06 Test Reports														
			Louvered penthouse		FIO												
			Automatic dampers	2.9.6	FIO												
			Sound pressure level rating	1.4.4	FIO												
			Louvers	2.9	FIO												
			Sound attenuators and attenuator ducts acoustical tests	1.4.5	FIO												
			Plenum or casing acoustical tests	1.4.6	FIO												
			Air duct leakage tests	3.2.1	FIO												
			SD-08 Manufacturer's Instructions														
			Ductwork and ductwork accessories	1.6.4	FIO												
			SD-11 Closeout Submittals														

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						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	A C T I O N  C O D E	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	A C T I O N  C O D E	DATE OF ACTION		
(a)	(b)	(c)	ITEM SUBMITTED (d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		15810N	Fibrous glass ducts		FIO												
		15951A	SD-02 Shop Drawings														
			HVAC Control System	3.1.1	G												
			SD-03 Product Data														
			Service Organizations		FIO												
			Equipment Compliance Booklet	1.6	FIO												
			Commissioning Procedures	3.4	G												
			Performance Verification Test	1.6	FIO												
			Procedures														
			Training	3.6	FIO												
			SD-06 Test Reports														
			Commissioning Report	3.6.2	FIO												
			Performance Verification Test	3.5.3	FIO												
			SD-07 Certificates														
			Air Storage Tank	2.13.1	FIO												
			SD-10 Operation and Maintenance														
			Data														
			Operation Manual	1.5	FIO												
			Maintenance and Repair Manual	1.6	FIO												
		15990A	SD-02 Shop Drawings														
			TAB Schematic Drawings and	3.3	G												
			Report Forms														
			SD-03 Product Data														
			TAB Related HVAC Submittals	3.2	FIO												
			TAB Procedures	3.5.1	G												
			Calibration	1.4	FIO												

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		15990A	Systems Readiness Check	3.5.2	FIO												
			TAB Execution	3.5.1	G												
			TAB Verification	3.5.4	G												
			SD-06 Test Reports														
			Design Review Report	3.1	G												
			Systems Readiness Check	3.5.2	G												
			TAB Report	3.5.3	G												
			TAB Verification Report	3.5.4	G												
			SD-07 Certificates														
			Ductwork Leak Testing	3.4	FIO												
			TAB Firm	1.5.1	G												
			TAB Specialist	1.5.2	G												
		16264A	SD-02 Shop Drawings														
			Layout		G												
			Drawings		G												
			Acceptance	3.9	G												
			SD-03 Product Data														
			Performance Tests	3.5.5	FIO												
			Sound Limitations	2.6	G												
			Generator	2.12	FIO												
			Integral Main Fuel Storage Tank	2.3.4	FIO												
			Power Factor	3.5.1.2	FIO												
			Time-Delay on Alarms	2.16.5	FIO												
			Cooling System	2.5	FIO												
			Manufacturer's Catalog	2.2	FIO												
			Vibration Isolation	1.4.8	FIO												

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(a)	(b)	(c)	ITEM SUBMITTED (d)	(e)	(f)	SUBMIT (g)	BY (h)	BY (i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	REMARKS (r)
		16264A	Instructions	3.8	G												
			Experience	1.4.9	FIO												
			Field Engineer	1.4.10	FIO												
			General Installation	3.1	FIO												
			Site Visit		FIO												
			SD-06 Test Reports														
			Onsite Inspection and Tests	3.5	G												
			SD-07 Certificates														
			Vibration Isolation	1.4.8	FIO												
			Prototype Tests		FIO												
			Reliability and Durability		FIO												
			Emissions	2.9	FIO												
			Sound limitations	2.6	FIO												
			Flywheel Balance		FIO												
			Materials and Equipment	2.1	FIO												
			Factory Inspection and Tests	2.25	FIO												
			Inspections	3.5.3	FIO												
			Cooling System	2.5	FIO												
		16375A	SD-02 Shop Drawings														
			Electrical Distribution System	3.8.3	FIO												
			As-Built Drawings		FIO												
			SD-03 Product Data														
			Nameplates	2.2	FIO												
			Material and Equipment	2.1	FIO												
			General Installation	3.1	FIO												
			Requirements														

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(a)	(b)	(c)	DESCRIPTION (d)	(e)	(f)	SUBMIT (g)	APPROVAL NEEDED (h)	MATERIAL NEEDED (i)	(j)	DATE OF ACTION (k)	DATE RCD FROM CONTR (l)	DATE FWD TO OTHER REVIEWER (m)	DATE RCD FROM OTH REVIEWER (n)	(o)	DATE OF ACTION (p)	DATE RCD FRM APPR AUTH (q)	REMARKS (r)	
		16375A	SD-06 Test Reports															
			Factory Tests	2.14	FIO													
			Field Testing	3.8	FIO													
			Operating Tests	3.8.6	FIO													
			Cable Installation	3.2.1.4	FIO													
			SD-07 Certificates															
			Material and Equipment	2.1	FIO													
			Cable Joints	3.3	FIO													
			Cable Installer Qualifications		FIO													
			SD-10 Operation and Maintenance															
			Data															
			Electrical Distribution System	3.8.3	FIO													
		16403A	SD-02 Shop Drawings															
			Drawings	2.4.2	G													
			Shop Drawings	2.2.1	G													
			Motor Control Centers	2.5	G													
			Switchboards	2.6	G													
			Panelboards	2.7	G													
			SD-03 Product Data															
			Equipment		G													
			Factory Tests	2.9	FIO													
			SD-06 Test Reports															
			Factory Tests	2.9	FIO													
			SD-07 Certificates															
			Motor Control Centers	2.5	FIO													
		16410A	SD-02 Shop Drawings															

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(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		16410A	Switches		FIO												
			Equipment	1.3.1	FIO												
			Installation	3.1	FIO												
			SD-03 Product Data														
			Material	1.3.1	FIO												
			Equipment	1.3.1	FIO												
			SD-06 Test Reports														
			Testing	2.3	G												
			SD-07 Certificates														
			Equipment	1.3.1	FIO												
			Material	1.3.1	FIO												
			Switching Equipment		FIO												
			SD-10 Operation and Maintenance														
			Data														
			Switching Equipment		FIO												
			Instructions	3.2	FIO												
		16415A	SD-02 Shop Drawings														
			Interior Electrical Equipment		FIO												
			SD-03 Product Data														
			Fault Current and Protective		FIO												
			Device Coordination Study														
			Manufacturer's Catalog		FIO												
			Material, Equipment, and Fixture		FIO												
			Lists														
			Installation Procedures		FIO												
			As-Built Drawings	1.2.6	FIO												

CONTRACT NO.

SUBMITTAL FORM, Jan 96

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE <small>(Read instructions on the reverse side prior to initiating this form)</small>						DATE		TRANSMITTAL NO.			
SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS <small>(This section will be initiated by the contractor)</small>											
TO:			FROM:			CONTRACT NO.		CHECK ONE: <input type="checkbox"/> THIS IS A NEW TRANSMITTAL <input type="checkbox"/> THIS IS A RESUBMITTAL OF TRANSMITTAL _____			
SPECIFICATION SEC. NO. <small>(Cover only one section with each transmittal)</small>			PROJECT TITLE AND LOCATION								
ITEM NO.	DESCRIPTION OF ITEM SUBMITTED <small>(Type size, model number/etc.)</small>	MFG OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. <small>(See instruction no. 8)</small>	NO. OF COPIES	CONTRACT REFERENCE DOCUMENT		FOR CONTRACTOR USE CODE	VARIATION <small>(See Instruction No. 6)</small>	FOR CE USE CODE			
a.	b.	c.	d.	SPEC. PARA. NO.	DRAWING SHEET NO.	e.	f.	g.	h.	i.	
REMARKS								I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as other wise stated.			
NAME AND SIGNATURE OF CONTRACTOR											
SECTION II - APPROVAL ACTION											
ENCLOSURES RETURNED <small>(List by Item No.)</small>				NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY				DATE			
ENG FORM 4025, May 91				(ER 415-1-10)				EDITION OF AUG 89 IS OBSOLETE.			
SHEET _____ OF _____				SHEET _____ OF _____				(Proprietor: CEMP-CE)			



## INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.
2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; on resubmittals, insert transmittal number of last submission as well as the new submittal number.
3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288 for each entry on this form.
4. Submittals requiring expeditious handling will be submitted on a separate form.
5. Separate transmittal form will be used for submittals under separate sections of the specifications.
6. A check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications--also, a written statement to that effect shall be included in the space provided for "Remarks".
7. Form is self-transmittal, letter of transmittal is not required.
8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.
9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I, column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g, to each item submitted.

### THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

A	--	Approved as submitted.	E	--	Disapproved (See attached).
B	--	Approved, except as noted on drawings.	F	--	Receipt acknowledged.
C	--	Approved, except as noted on drawings. Refer to attached sheet resubmission required.	FX	--	Receipt acknowledged, does not comply as noted with contract requirements.
D	--	Will be returned by separate correspondence.	G	--	Other (Specify)

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

SECTION 01451

CONTRACTOR QUALITY CONTROL  
11/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740	(1999b) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E 329	(1998a) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Price Schedule.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

CQC Plan; G AR.

Identifies personnel, procedures, control, instructions, test, records, and forms to be used.

Phase Notification

The Government shall be notified in a specified amount of time in advance of beginning the preparatory control phase.

Request; G AR.

The requesting of specialized individuals in specific disciplines to perform quality control.

CQC Mgr Qualification; G AR.

The evaluation of the project to determine the level of CQC System Manager required.

SD-02 Shop Drawings

Coordination Drawings

Provide coordination drawings for installation of products and materials fabricated by separate entities.

SD-05 Design Data

Notification of Changes

Any changes made by the Contractor.

Punchlist

Near the completion of all work, the CQC System Manager shall prepare a list of items which do not conform to the approved drawings and specifications.

Minutes

Prepared by the Government and signed by both the Contractor and the Contracting Officer and shall become a part of the contract file.

SD-06 Test Reports

Tests

Specified or required tests shall be done by the Contractor to verify that control measures are adequate.

Documentation

Results of tests taken.

Tests Performed

An information copy provided directly to the Contracting Officer.

QC Records; G AR.

Provide factual evidence that required quality control activities and/or tests have been performed.

## PART 2 PRODUCTS (Not Applicable)

## PART 3 EXECUTION

## 3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.

## 3.2 CQC PLAN

## 3.2.1 General

The Contractor shall furnish for review by the Government, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 60 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

## 3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

- a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.
- b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC

function.

- c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.
- d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.
- e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. The Contractor shall include a copy of his proposed laboratory's latest Corps of Engineers inspection report in the Quality Control Plan. The inspection report details the tests that the lab has been validated to perform under Corps of Engineers contracts. (Laboratory facilities will be approved by the Contracting Officer.)
- f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.
- g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.
- h. Reporting procedures, including proposed reporting formats.
- i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

### 3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and

operations including removal of personnel, as necessary, to obtain the quality specified.

#### 3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

#### 3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 14 calendar days prior to the Coordination Meeting.

During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

#### 3.4 QUALITY CONTROL ORGANIZATION

##### 3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, show drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

##### 3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within

the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 3 years construction experience on construction similar to this contract, or a construction person with a minimum of 5 years in related work. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned as System Manager but may have duties as project superintendent in addition to quality control. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

#### 3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: electrical, mechanical, architectural, . These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan.

#### Experience Matrix

<u>Area</u>	<u>Qualifications</u>
b. Mechanical	Graduate Mechanical Engineer with 2 yrs experience or person with 5 yrs related experience
c. Electrical	Graduate Electrical Engineer with 2 yrs related experience or person with 5 yrs related experience
e. Architectural	Graduate Architect with 2 yrs experience or person with 5 yrs related experience

#### 3.4.4 Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management for Contractors" within 45 calendar days after NTP is a mandatory requirement for the position of the Quality Control Systems

Manager. Certification is good for five (5) years at which time re-training is required. The Contractor's QC Systems Manager may be appointed and serve fully in that capacity pending certification. If the CQC Systems Manager fails to successfully complete the training, the Contractor should promptly appoint a new CQSM who shall then attend the next available course. The course is nine (9) hours long (1 day). The Construction Quality Management Course (CQMC) will be taught at least nine (9) times per year by the Baltimore District Corps of Engineers, at various locations around Baltimore and Washington, DC, or at another site if conditions warrant. The CQMC cost will be borne by the Contractor and is one hundred and twenty-five dollars (\$125.00) per course, per person. Payment shall be made by check payable to either sponsors of the course: Associated Builders and Contractors, Inc, (ABC) 14120 Park Long Court, Suite 111, Chantilly, Virginia 20151 (Phone: 703-968-6205), or to The Associated General Contractors of America (AGC), Maryland Chapter, 1301 York Road, Heaver Plaza, Suite 202, Lutherville, Maryland 21093 (Phone: 410-321-7870) prior to the start of the course. Reservations to attend the course should be made directly to the organization sponsoring the course they attend. The Contractor has forty-five (45) calendar days to attend the course after the issuance of the NTP. The contractor shall contact the Contracting Officer upon award of the contract for arrangements for the course.

#### 3.4.5 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

#### 3.5 SUBMITTALS

Submittals, if needed, shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

#### 3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

##### 3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

- a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced



codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.

- b. A review of the contract drawings.
- c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. Review of provisions that have been made to provide required control inspection and testing.
- e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.
- f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.
- g. A review of the appropriate activity hazard analysis to assure safety requirements are met.
- h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.
- i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.
- j. Discussion of the initial control phase.
- k. The Government shall be notified at least 72 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

### 3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

- a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.
- b. Verify adequacy of controls to ensure full contract compliance.

Verify required control inspection and testing.

- c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
- d. Resolve all differences.
- e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
- f. The Government shall be notified at least 72 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
- g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

#### 3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

#### 3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable, if there are changes in the applicable CQC staff, onsite production supervision or work crew, if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

#### 3.7 COORDINATION DRAWINGS

- a. The Contractor shall prepare coordination drawings, drawn accurately to scale. Coordination drawings shall not be reproductions of the Contract Documents or standard printed data. The following information shall be included:

- (1) Functional and spatial relationship of components of architectural, structural, mechanical, electrical, theatrical lighting and audio systems.
- (2) Required installation sequences.
- (3) Dimensions shown on the Contract Drawings, with specific note made of dimensions that appear to be in conflict with submitted

equipment and minimum clearance requirements. Alternate sketches shall be provided to the Government for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

- b. Sheet size: At least 8-1/2 inches by 11 inches but no larger than 24 by 36 inches.

### 3.8 TESTS

#### 3.8.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. The Contractor shall perform the following activities and record and provide the following data:

- a. Verify that testing procedures comply with contract requirements.
- b. Verify that facilities and testing equipment are available and comply with testing standards.
- c. Check test instrument calibration data against certified standards.
- d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

#### 3.8.2 Testing Laboratories

##### 3.8.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740

and ASTM E 329.

#### 3.8.2.2 Laboratory Approval

The Contractor shall use a testing laboratory that has been previously approved by the Corps of Engineers or obtain approval for a laboratory established at the project site. Approved laboratories are listed at the following web site: <http://www.wes.army.mil/SL/MTC/ValStatesTbl.htm> If the Contractor elects to set up an on-site laboratory at the project site, the Contractor will be assessed \$4500.00 for the cost of inspection of this lab by the Corps of Engineers.

#### 3.8.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

#### 3.8.4 Furnishing or Transportation of Samples for Testing

Furnishing or Transportation of Samples for Testing: Costs incidental to the transportation of samples or materials will be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the following address:

Field Exploration Unit  
or  
Soils Laboratory Unit  
(indicate which on shipping or mailing forms)  
Fort McHenry Yard  
Baltimore, Maryland 21230"

#### 3.9 SHAKE-OUT COMMISSIONING AND DRESS REHEARSAL

After performing commissioning of individual systems, the Contractor shall perform a "Shake-Out" Commissioning of the Performance Hall, of all operable systems and controls in concert with each other, a minimum of 6 (six) weeks prior to the Contracting Officer-accepted Project Completion Date. All building systems having an impact on the lighting, AV sound and acoustical properties including, but not limited to, all MEP systems, acoustical wall treatments, sound isolation treatments to HVAC, pipes, conduit, etc., all doors, windows and window treatments, seating and performance flooring are to be complete to a point of allowing the Hall to function as if 100% complete.

This "Shake-Out" Commissioning is to be coordinated as necessary with the Contracting Officer so as to involve the end users in a "Dress Rehearsal" type performance in a scope and of a duration as determined suitable by the Contracting Officer. The duration of this commissioning is not to exceed 1 (one) working day.

Refer to individual specification sections for sound systems and theatrical lighting equipment for detailed requirements for acceptance testing and

demonstration of completed installation, and coordinate with the Government regarding these requirements.

### 3.10 COMPLETION INSPECTION

#### 3.10.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Special Clause in Section 00800 of the Solicitation entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the CQC System Manager shall conduct an inspection of the work and develop a punchlist of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

#### 3.10.2 Pre-Final Inspection

The Government will perform pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

#### 3.10.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

## 3.11 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.
- c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
- d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
- e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- f. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.
- g. Off-site surveillance activities, including actions taken.
- h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- i. Instructions given/received and conflicts in plans and/or specifications.
- j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of

test reports and copies of reports prepared by all subordinate quality control personnel.

3.12 SAMPLE FORMS

Sample forms enclosed at the end of this section.

3.13 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

-- End of Section --

04/1998

Contractor's Name:	_____
Address:	_____ _____
Phone Number:	_____

CONSTRUCTION QUALITY CONTROL REPORT

PROJECT NAME: \_\_\_\_\_  
LOCATION: \_\_\_\_\_ DATE: \_\_\_\_\_  
CONTRACT NUMBER: \_\_\_\_\_ REPORT NO.: \_\_\_\_\_

SUPERINTENDENT: _____			
TYPE OF WORKERS	NUMBER	TYPES OF CONSTRUCTION EQUIPMENT ON SITE	NUMBER
SUBCONTRACTORS			
COMPANY	RESPONSIBILITY	FOREMAN	NO. OF WORKERS
TOTALS			
NO. OF WORKERS TODAY	MANHOURS TODAY	MANHOURS FOR THIS PERIOD	
CONTRACT MATERIALS AND EQUIPMENT DELIVERED TO SITE:			
WEATHER: _____ SITE CONDITIONS: _____			
DID A DELAY OR WORK STOPPAGE OCCUR TODAY? _____ IF YES, EXPLAIN.			
HAS ANYTHING DEVELOPED IN THE WORK WHICH MAY LEAD TO A CHANGE OR FINDING OF FACT? _____ IF YES, EXPLAIN.			



DESCRIPTION OF ALL WORK PERFORMED TODAY  
(LIST BY DEFINABLE FEATURES OF WORK)

PREPARATORY INSPECTION:

LIST ALL INSPECTIONS BY SUBJECT AND SPECIFICATION LOCATION.  
ATTACH MINUTES OF MEETING AND LIST OF ALL ATTENDEES.

HAVE ALL REQUIRED SUBMITTALS AND SAMPLES OF CONSTRUCTION BEEN  
APPROVED.

DO THE MATERIALS AND EQUIPMENT TO BE USED CONFORM TO THE SUBMITTALS?

HAS ALL PRELIMINARY WORK BEEN INSPECTED, TESTED, AND COMPLETED?

TEST REQUIRED AND INSPECTION TECHNIQUES TO BE EXECUTED TO PROVE  
CONTRACT COMPLIANCE (INCLUDE BOTH EXPECTED AND ACTUAL RESULTS)

HAS A PHASE HAZARD ANALYSIS BEEN PERFORMED?

COMMENTS AND DEFICIENCIES NOTED AND CORRECTIVE ACTIONS TAKEN:

ALL INSTRUCTIONS RECEIVED FROM QA PERSONNEL AND ACTIONS TAKEN:

JOB SAFETY (INCLUDE MEETINGS HELD AND DEFICIENCIES NOTED WITH  
CORRECTIVE ACTIONS):

INITIAL INSPECTION:

LIST ALL INSPECTIONS BY SUBJECT AND SPECIFICATION LOCATION.  
COMMENTS AND/OR DEFICIENCIES NOTED AND CORRECTIVE ACTION TAKEN:

FOLLOW-UP INSPECTION:

LIST ALL INSPECTIONS BY SUBJECT AND SPECIFICATION LOCATION.  
COMMENTS AND/OR DEFICIENCIES NOTED AND CORRECTIVE ACTION TAKEN.

SIGNATURE: \_\_\_\_\_  
QUALITY CONTROL REPRESENTATIVE/MANAGER

THE ABOVE REPORT IS COMPLETE AND CORRECT. ALL MATERIALS AND  
EQUIPMENT USED AND ALL WORK PERFORMED DURING THIS REPORTING PERIOD  
ARE IN COMPLIANCE WITH THE CONTRACT SPECIFICATIONS, AND SUBMITTALS,  
EXCEPT AS NOTED ABOVE.

SIGNATURE: \_\_\_\_\_  
CONTRACTOR'S APPROVED AUTHORIZED REPRESENTATIVE

## SECTION 01420

## SOURCES FOR REFERENCE PUBLICATIONS

03/01

## 1. GENERAL

## 1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

## 1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

## ACI INTERNATIONAL (ACI)

P.O. Box 9094  
Farmington Hills, MI 48333-9094  
Ph: 248-848-3700  
Fax: 248-848-3701  
Internet: <http://www.aci-int.org>  
AOK 6/00  
LOK 6/00

## ACOUSTICAL SOCIETY OF AMERICA (ASA)

2 Huntington Quadrangle  
Melville, NY 11747-4502  
Ph: 516-576-2360  
Fax: 516-576-2377  
email: [asa@aip.org](mailto:asa@aip.org)  
Internet: <http://asa@aip.org>  
AOK 6/00  
LOK 6/00

## AGRICULTURAL MARKETING SERVICE (AMS)

Seed Regulatory and Testing Branch

USDA, AMS, LS Div.  
Room 209, Bldg. 306, BARC-East  
Beltsville, MD 20705-2325  
Ph: 301-504-9430  
Fax: 301-504-8098  
Internet: <http://www.ams.usda.gov/lsg>  
e-mail: [james\\_p\\_triplett@usda.gov](mailto:james_p_triplett@usda.gov)  
AOK 6/00  
LOK 6/00

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

4301 North Fairfax Dr., Suite 425  
ATTN: Pubs Dept.  
Arlington, VA 22203  
Ph: 703-524-8800  
Fax: 703-528-3816  
E-mail: [ari@ari.org](mailto:ari@ari.org)  
Internet: [www.ari.org](http://www.ari.org)  
AOK 6/00  
LOK 6/00

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)

1712 New Hampshire Avenue, NW  
Washington, DC 20009  
Ph: 202-483-9370  
FAX: 202-588-1217  
Intrnet: [www.acca.org](http://www.acca.org)  
AOK 6/00  
LOK 6/00

AIR DIFFUSION COUNCIL (ADC)

104 So. Michigan Ave., No. 1500  
Chicago, IL 60603  
Ph: 312-201-0101  
Fax: 312-201-0214  
Internet: [www.flexibleduct.org](http://www.flexibleduct.org)  
AOK 6/00  
LOK 6/00

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

30 W. University Dr.  
Arlington Heights, IL 60004-1893  
Ph: 847-394-0150  
Fax: 847-253-0088  
Internet: [www.amca.org](http://www.amca.org)  
AOK 6/00  
LOK 6/00

ALUMINUM ASSOCIATION (AA)

ALUMINUM ASSOCIATION (AA)

900 19th Street N.W.  
Washington, DC 20006  
Ph: 202-862-5100  
Fax: 202-862-5164  
Internet: [www.aluminum.org](http://www.aluminum.org)  
AOK 6/00  
LOK 6/00

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

1827 Walden Ofc. Sq.  
Suite 104  
Schaumburg, IL 60173-4268  
Ph: 847-303-5664  
Fax: 847-303-5774  
Internet: [www.aamanet.org](http://www.aamanet.org)  
AOK 6/00  
LOK 6/00

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

444 N. Capital St., NW, Suite 249  
Washington, DC 20001  
Ph: 800-231-3475 202-624-5800  
Fax: 800-525-5562 202-624-5806  
Internet: [www.aashto.org](http://www.aashto.org)  
AOK 6/00  
LOK 6/00

NOTE: AASHTO documents with numbers beginning with M or T are  
available only in Standard Specifications for Transportation  
Materials and Methods of Sampling and Testing, 1998 @\$289.00\X

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

P.O. Box 12215  
1 Davis Drive  
Research Triangle Park, NC 27709-2215  
Ph: 919-549-8141  
Fax: 919-549-8933  
Internet: [aatcc.org](http://aatcc.org)  
AOK 6/00  
LOK 6/00

AMERICAN BEARING MANUFACTURERS ASSOCIATION (AFBMA)

1200 19th Street, NW, Suite 300  
Washington, DC 20036-2422  
Ph: 202-429-5155  
Fax: 202-828-6042

Internet: abma-dc.org  
AOK 6/00  
LOK 6/00

AMERICAN BOILER MANUFACTURERS ASSOCIATION (ABMA)

950 North Glebe Road, Suite 160  
Arlington, Virginia 22203-1824  
Ph: 703-522-7350  
Fax: 703-522-2665  
Internet: abma.com  
AOK 6/00  
LOK 6/00

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

222 West Las Colinas Blvd., Suite 641  
Irving, TX 75039-5423  
Ph: 972-506-7216  
Fax: 972-506-7682  
Internet: <http://www.concrete-pipe.org>  
e-mail: [info@concrete-pipe.org](mailto:info@concrete-pipe.org)  
AOK 6/00  
LOK 6/00

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

1330 Kemper Meadow Dr.  
Suite 600  
Cincinnati, OH 45240  
Ph: 513-742-2020  
Fax: 513-742-3355  
Internet: [www.acgih.org](http://www.acgih.org)  
E-mail: [pubs@acgih.org](mailto:pubs@acgih.org)  
AOK 6/00  
LOK 6/00

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)

American Wood Council  
ATTN: Publications Dept.  
1111 Nineteenth St. NW, Suite 800  
Washington, DC 20036  
Ph: 800-294-2372 202-463-2700  
Fax: 202-463-2471  
Internet: <http://www.afandpa.org>  
AOK 6/00  
LOK 6/00

AMERICAN GAS ASSOCIATION (AGA)

400 N. Capitol St. N.W. Suite 450  
Washington, D.C. 20001  
Ph: 202-824-7000

Fax: 202-824-7115  
Internet: [www.aga.org](http://www.aga.org)  
AOK 6/00  
LOK 6/00

AMERICAN GAL ASSOCIATION LABORATORIES (AGAL)

Address  
Ph:  
Fax:  
Internet:

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

1500 King St., Suite 201  
Alexandria, VA 22314-2730  
Ph: 703-684-0211  
Fax: 703-684-0242  
Internet: [www.agma.org](http://www.agma.org)  
AOK 6/00  
LOK 6/00

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

One East Wacker Dr., Suite 3100  
Chicago, IL 60601-2001  
Ph: 312-670-2400  
Publications: 800-644-2400  
Fax: 312-670-5403  
Internet: [www.aisc.org](http://www.aisc.org)  
AOK 6/00  
LOK 6/00

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

7012 So. Revere Parkway, Suite 140  
Englewood, CO 80112  
Ph: 303-792-9559  
Fax: 303-792-0669  
Internet: [www.aitc-glulam.org](http://www.aitc-glulam.org)  
AOK 6/00  
LOK 6/00

AMERICAN IRON AND STEEL INSTITUTE (AISI)

1101 17th St., NW Suite 1300  
Washington, DC 20036  
Ph: 202-452-7100  
AOK 6/00  
LOK 6/00

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

11 West 42nd St  
New York, NY 10036  
Ph: 212-642-4900  
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E-Mail: [info@pdionline.org](mailto:info@pdionline.org)  
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PLUMBING AND PIPING INDUSTRY COUNCIL (PPIC)

9450 SW Commerce Circle, Suite 310  
wilsonville, OR 97070-9626  
Ph: 503-682-7919

PORCELAIN ENAMEL INSTITUTE (PEI)

P.O.Box 158541  
4004 Hillsboro Pike, Suite 224B  
Nashville, TN 37215  
Ph: 615-385-5357  
Fax: 615-385-5463  
Internet: [www.porcelainenamel.com](http://www.porcelainenamel.com)  
e-mail: [penamel@aol.com](mailto:penamel@aol.com)  
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Chicago, IL 60606-6938  
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Fax: 312-786-0353  
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e-mail: [info@pci.org](mailto:info@pci.org)

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RUBBER MANUFACTURERS ASSOCIATION (RMA)

1400 K St., NW, Suite 900  
Washington, DC 20005  
Ph: 202-682-4800  
Fax: 202-682-4854  
Internet: [www.rma.org](http://www.rma.org)  
Order Publications from:  
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Ph: 800-325-5095 EXT 242 or 330-723-2978  
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RURAL UTILITIES SERVICE (RUS)

ATTN: Publications  
14th and Independence Ave., SW, Room 4028-S  
Washington, DC 20250  
Ph: 202-720-8674 OR 202-720-8679  
Fax: 202-205-3654  
Internet: [www.usda.gov/rus](http://www.usda.gov/rus)

SCREEN MANUFACTURERS ASSOCIATION (SMA)

2850 South Ocean Boulevard, Suite 311  
Palm Beach, FL 33480-5535  
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Fax: 561-533-7466  
e-mail: [fscottfitzgerald@compuserve.com](mailto:fscottfitzgerald@compuserve.com)  
Internet: [www.eren.doe.gov](http://www.eren.doe.gov)  
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SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION  
(SMACNA)

4201 Lafayette Center Dr.,  
Chantilly, VA 20151-1209  
Ph: 703-803-2980  
Fax: 703-803-3732  
Internet: <http://www.smacna.org>  
e-mail: [info@smacna.org](mailto:info@smacna.org)  
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SINGLE PLY ROOFING INSTITUTE (SPRI)

SINGLE PLY ROOFING INSTITUTE (SPRI)

200 Reservoir St., Suite 309A  
Needham, MA 02494  
Ph: 781-444-0242  
Fax: 781-444-6111  
Internet: [www.spri.org](http://www.spri.org)  
e-mail: [spri@spri.org](mailto:spri@spri.org)  
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SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

400 Commonwealth Dr.  
Warrendale, PA 15096-0001  
Ph: 724-776-4841  
Fax: 724-776-5760  
Internet: <http://www.sae.org>  
e-mail: [publications@sae.org](mailto:publications@sae.org)  
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SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI)

900 Montclair Road  
Birmingham, AL 35213-1206  
Ph: 205-591-1853  
Fax: 205-591-0775  
Internet: [www.sbcci.org](http://www.sbcci.org)  
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SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

400 Penn Center Boulevard, Suite 530  
Pittsburgh, PA 15235  
Ph: 412-829-0770  
Fax: 412-829-0844  
Internet: [www.cypressinfo.org](http://www.cypressinfo.org)  
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SOUTHERN PINE INSPECTION BUREAU (SPIB)

4709 Scenic Highway  
Pensacola, FL 32504-9094  
Ph: 850-434-2611  
Fax: 850-433-5594  
e-mail: [spib@spib.org](mailto:spib@spib.org)  
Internet: [www.spib.org](http://www.spib.org)  
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THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

40 24th Street, 6th Floor  
Pittsburgh, PA 15222-4656  
Ph: 412-281-2331  
Fax: 412-281-9992  
Internet: [www.sspc.org](http://www.sspc.org)  
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NOTE: SSPC documents, except as noted otherwise, are available only as a part of the 1995 Steel Structures Painting Manual, 7th Edition @ \$115.00.

STEEL DECK INSTITUTE (SDI)

P.O. Box 25  
Fox River Grove, IL 60021-0025  
Ph: 847-462-1930  
Fax: 847-462-1940  
Internet: <http://www.sdi.org>  
e-mail: [Steve@sdi.org](mailto:Steve@sdi.org)  
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STEEL DOOR INSTITUTE (SDOI)

30200 Detroit Rd.  
Cleveland, OH 44145-1967  
Ph: 440-899-0010  
Fax: 440-892-1404  
Internet: [www.steeldoors.org](http://www.steeldoors.org)  
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STEEL JOIST INSTITUTE (SJI)

3127 Tenth Ave., North Ext.  
Myrtle Beach, SC 29577-6760  
Ph: 843-626-1995  
Fax: 843-626-5565  
Internet: [www.steeljoist.org](http://www.steeljoist.org)  
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STEEL TANK INSTITUTE (STI)

570 Oakwood Rd.  
Lake Zurich, IL 60047  
Ph: 847-438-8265  
Fax: 847-438-8766  
Internet: [www.steeltank.com](http://www.steeltank.com)  
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STEEL WINDOW INSTITUTE (SWI)

1300 Sumner Ave.  
Cleveland, OH 44115-2851  
Ph: 216-241-7333  
Fax: 216-241-0105  
Internet: [www.steelwindows.com](http://www.steelwindows.com)  
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TILE COUNCIL OF AMERICA (TCA)

100 Clemson Research Blvd  
Anderson, SC 29625  
Ph: 864-646-8453  
FAX: 864-646-2821  
Internet: [www.tileusa.com](http://www.tileusa.com)  
e-mail: [literature@tileusa.com](mailto:literature@tileusa.com)  
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TRUSS PLATE INSTITUTE (TPI)

583 D'Onofrio Dr., Suite 200  
Madison, WI 53719  
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Fax: 608-833-4360  
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25 N. Broadway  
Tarrytown, NY 10591  
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Fax: 914-332-1541  
Internet: [www.tema.org](http://www.tema.org)  
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UNDERWRITERS LABORATORIES (UL)

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Northbrook, IL 60062-2096  
Ph: 847-272-8800  
Fax: 847-272-8129  
Internet: <http://www.ul.com/>  
e-mail: [northbrook@us.ul.com](mailto:northbrook@us.ul.com)  
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Note: First price is for the standard only. Second price is for

the standard including the Revision Subscription Service.

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

2655 Villa Creek Dr., Suite 155  
Dallas, TX 75234  
Ph: 214-243-3902  
Fax: 214-243-3907  
Internet: [www.uni-bell.org](http://www.uni-bell.org)  
e-mail: [info@uni-bell.org](mailto:info@uni-bell.org)  
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U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY (USAEHA)

Waste Disposal Engineering Division  
Aberdeen Proving Ground, MD 21010-5422  
Ph: 410-436-3652

WATER ENVIRONMENT FEDERATION (WEF)

601 Wythe St.  
Alexandria, VA 22314-1994  
Ph: 703-684-2452  
Fax: 703-684-2492  
Internet: [www.wef.org](http://www.wef.org)  
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WATER QUALITY ASSOCIATION (WQA)

4151 Naperville Rd.  
Lisle, IL 60532  
Ph: 630-505-0160  
Fax: 630-505-9637  
Internet: [www.wqa.org](http://www.wqa.org)  
e-mail: [info@mail.wqa.org](mailto:info@mail.wqa.org)  
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WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

P.O. Box 23145  
Portland, OR 97281  
Ph: 503-639-0651  
Fax: 503-684-8928  
internet: [www.wclib.org](http://www.wclib.org)  
e-mail: [info@wclib.org](mailto:info@wclib.org)  
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WESTERN WOOD PRESERVERS INSTITUTE (WWPI)

WESTERN WOOD PRESERVERS INSTITUTE (WWPI)

7017 N.E. Highway 99 # 108  
Vancouver, WA 98665  
Ph: 360-693-9958  
Fax: 360-693-9967  
Internet: [www.awpi.org/wwpi](http://www.awpi.org/wwpi)  
e-mail: [wwpi@teleport.com](mailto:wwpi@teleport.com)  
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WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

Yeon Bldg.  
522 SW 5th Ave.  
Suite 500  
Portland, OR 97204-2122  
Ph: 503-224-3930  
Fax: 503-224-3934  
Internet: [www.wwpa.org](http://www.wwpa.org)  
e-mail: [info@wwpa.org](mailto:info@wwpa.org)  
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WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMPMA)

507 First Street  
Woodland, CA 95695  
Ph: 916-661-9591  
Fax: 916-661-9586  
Internet: [www.wmmpa.com](http://www.wmmpa.com)  
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-- End of Section --

## SECTION 01452A

SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS  
**11/99**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 318/318R (2002) Building Code Requirements for  
Structural Concrete and Commentary

ACI 530/530.1 (2002) Building Code Requirements for  
Masonry Structures and Specifications for  
Masonry Structures and Commentaries

## ASTM INTERNATIONAL (ASTM)

ASTM A 435/A 435M (1990; R 2001) Straight-Beam Ultrasonic  
Examination of Steel Plates

ASTM A 615/A 615M (2003a) Deformed and Plain Billet-Steel  
Bars for Concrete Reinforcement

ASTM A 898/A 898M (1991; R 2001) Straight Beam Ultrasonic  
Examination of Rolled Steel Structural  
Shapes

## U.S. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA 302 (Feb 1998) NEHRP Recommended Provisions  
for Seismic Regulations for New Buildings  
and Other Structures

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

## Special Inspector; G

Certification attesting that the Special Inspector is qualified by knowledge and experience to perform the specified Special Inspections. Information, which provides evidence of the knowledge and experience necessary to qualify a person as a Special Inspector for the category of work being certified, will accompany the qualification.

## Quality Assurance Plan; G, A/E

A copy of the Quality Assurance Plan covered by a certificate indicating that the plan meets the content specified in this section.

## 1.3 SPECIAL INSPECTOR

A Special Inspector shall be used to perform Special Inspections required by this section. The Special Inspector is a person employed by the Contractor and approved by the Government as being qualified by knowledge and experience to perform the Special Inspection for the category of work being constructed. Special Inspectors shall perform their duties independent from the construction quality control staff employed by the Contractor. More than one Special Inspector may be required to provide the varied knowledge and experience necessary to adequately inspect all of the categories of work requiring Special Inspection.

## 1.4 QUALITY ASSURANCE PLAN

A quality assurance plan shall be developed containing the following:

- a. A list of all Items that require quality assurance Special Inspection and testing, including the type, frequency, extent, and duration of the special inspection for each item on this list.
- b. A list of all items that require quality assurance testing, including the type and frequency of testing for each item on this list.
- c. The content, distribution, and frequency of special inspection reports.
- d. The content, distribution, and frequency of testing reports.
- e. The procedures, controls, and people used within the Contractor's organization to develop, sign, and distribute Special Inspection and Testing reports along with the position title and pertinent qualifications of all Contractor personnel involved.

## 1.5 SPECIAL INSPECTION

The Special Inspection for seismic-resisting system components shall be done as specified. Special Inspector personnel shall be in addition to the

quality control inspections and inspectors required elsewhere in this section.

#### 1.5.1 Continuous Special Inspection

Continuous special inspection is the full time observation of the work by the Special Inspector present in the work area whenever work is being performed. Continuous special inspection shall be performed where specified for items as shown on the drawings.

#### 1.5.2 Periodic Special Inspection

Periodic special inspection is the intermittent observation of the work by a Special Inspector present in the work area while work is being performed. The intermittent observation periods shall be at times of significant work, shall be recurrent over the complete work period, and shall total at least 25 percent of the total work time. Periodic special inspection shall be performed where specified for items as shown on the drawings.

### PART 2 PRODUCTS

Not Used

### PART 3 EXECUTION

#### 3.1 PERFORMANCE OF INSPECTIONS

Special Inspections shall be performed for the following where designated on the drawings:

##### 3.1.1 Structural Concrete

Periodic special inspection during and on completion of the placement of concrete in concrete in handicap ramps, stairs, and platforms.

##### 3.1.2 Structural Masonry

a. Periodic special inspection during the preparation of mortar, the laying of masonry units, and placement of reinforcement and prior to placement of grout.

b. Continuous special inspection during the welding of reinforcement, grouting, consolidation and reconsolidation.

##### 3.1.3 Structural Steel

a. Continuous special inspection for all structural welding, except that periodic special inspection is permitted for single-pass or resistance welds and welds loaded to less than 50 percent of their design strength provided the qualifications of the welder and the welding electrodes are inspected at the beginning of the work and all welds are inspected for compliance with the approved construction documents at the completion of welding.

b. Periodic special inspection in accordance with AISC 350 for the installation of bolts in special concentrically braced frames and eccentrically braced frames except that bolts not required to be fully tensioned need not be inspected for bolt tension, other than to ensure that the plies of the connected elements have been brought into snug contact

#### 3.1.4 Structural Wood

a. Periodic special inspections for nailing, bolting, anchoring, and other fastening of components within the seismic-force-resisting system including drag struts braces, and tie-downs.

#### 3.1.5 Cold-Formed Steel Framing

a. Periodic special inspections during all welding operations of elements of the seismic-force-resisting system.

b. Periodic special inspections for screw attachment, bolting, anchoring, and other fastening of components within the seismic-force-resisting system, including struts, braces, and hold-downs.

#### 3.1.6 Architectural Components

Special inspection of the architectural components shall assure that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the components, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for architectural components shall be as follows:

a. Periodic special inspection during the erection and fastening of interior nonloadbearing partition walls and masonry veneer.

b. Periodic special inspection during the anchorage of access floors, handicap ramps and stairs.

#### 3.1.7 Mechanical and Electrical Components

Special inspection of the mechanical and electrical components shall assure that the methods of anchoring and fastening indicated on the shop drawings are being complied with at the onset of construction of the component, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for mechanical and electrical components shall be as follows:

a. Periodic special inspection during the anchorage of electrical equipment for emergency or standby power systems.

b. Periodic special inspection during the installation of anchorage of all other electrical equipment.

d. Periodic special inspection during the installation of HVAC ductwork.

#### 3.1.8 Seismic Isolation System

Periodic special inspection during the fabrication and installation of isolator units.

#### 3.1.9 Energy Dissipation System

Periodic special inspection during the fabrication and installation of energy dissipation devices.

### 3.2 TESTING

The special inspector shall be responsible for verifying that the testing requirements are performed by an approved testing agency for compliance with the following, where shown on the drawings:

a. Structural Masonry: Verify that all quality assurance testing of structural masonry along with all material components is in accordance with the requirements of ACI 530/530.1 and complies with all acceptance provisions contained therein.

b. Structural Steel:

(1) Verify that all quality assurance testing needed to confirm required material properties given in the quality assurance plan has been done in accordance with applicable provisions in AISC 341 and AISC 350 and that the test results comply with all acceptance provisions contained therein.

(2) When a flange or a plate of steel member with a base metal thickness greater than 1.5 inches, is joined by welding so that the flange or plate is subjected to through-thickness weld shrinkage strains, verify that the required ultrasonic testing for discontinuities behind and adjacent to such welds has been done after joint completion. Further verify that any material discontinuities rejected on the basis of the requirements contained in ASTM A 435/A 435M or ASTM A 898/A 898M, (Level 1 Criteria) were repaired and were retested after the repairs and found acceptable.

c. Seismically Isolated Structures: Verify that the required system and component tests for seismically isolated structures have been done in accordance with FEMA 302 and comply with all acceptance provisions contained therein.

d. Energy Dissipation Systems: Verify that the required system and component tests for seismic energy dissipation systems have been done in accordance with FEMA 302 and comply with all acceptance provisions contained therein.



### 3.3 REPORTING AND COMPLIANCE PROCEDURES

- a. On the first day of each month, the Contractor shall furnish to the Government five copies of the combined progress reports of the special inspector's observations. These progress reports shall list all special inspections of construction or reviews of testing performed during that month, note all uncorrected deficiencies, and describe the corrections made both to these deficiencies and to previously reported deficiencies. Each monthly report shall be signed by all special inspectors who performed special inspections of construction or reviewed testing during that month, regardless of whether they reported any deficiencies. Each monthly report shall be signed by the Contractor.
- b. At completion of construction, each special inspector shall prepare and sign a final report attesting that all work they inspected and all testing and test reports they reviewed were completed in accordance with the approved construction documents and that deficiencies identified were satisfactorily corrected. The Contractor shall submit a combined final report containing the signed final reports of all the special inspectors. The Contractor shall sign the combined final report attesting that all final reports of special inspectors that performed work to comply with these construction documents are contained therein, and that the Contractor has reviewed and approved all of the individual inspector's final reports.

-- End of Section --

SECTION 01510

TEMPORARY CONSTRUCTION ITEMS

09/03

PART 1 GENERAL

1.1 GENERAL

The work covered by this section consists of furnishing all labor, materials, equipment, and services and performing all work required for or incidental to the items herein specified. No separate payment will be made for the construction and services required by this section, and all costs in connection therewith shall be included in the overall cost of the work unless specifically stated otherwise.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-58060

Fluorocarbon and Other Refrigerants

U.S. ARMY CORPS OF ENGINEERS

EM 385-1-1

(03 Nov 03) Safety - Safety and Health Requirements

EP310-1-6A and EP 310-1-6B

Sign Standards Manual, VOL 1 CH 1 and VOL 2 CH 1

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Temporary Electrical Work; G AR.

The Contractor shall submit a temporary power distribution sketch prior to the installation of any temporary power.

#### 1.4 GENERAL REQUIREMENTS

##### 1.4.1 Site Plan

The Contractor shall prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is desired.

##### 1.4.2 Identification of Employees

The Contractor shall be responsible for furnishing to each employee, and for requiring each employee engaged on the work to display, identification as approved and directed by the Contracting Officer. Prescribed identification shall immediately be delivered to the Contracting Officer for cancellation upon release of any employee. When required, the Contractor shall obtain and provide fingerprints of persons employed on the project. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

##### 1.4.3 Employee Parking

Contractor employees shall park privately owned vehicles in an area designated by the Contracting Officer. This area will be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the military installation.

#### 1.5 PROJECT SIGN: (AUG 1974)

A project sign shall be provided and erected at a location designated by the Contracting Officer. The sign shall conform to the applicable requirements of EP 310-1-6A and EP 310-1-6B. The sign shall be erected as soon as possible and within 15 days after the date of receipt of notice to proceed. Upon completion of the project, the sign shall be removed and disposed of by the Contractor. (CENAB)

#### 1.6 SAFETY SIGN (AUG 1974)

A safety sign shall be provided and erected at a location designated by the Contracting Officer. The sign shall conform to the applicable requirements of EP 310-1-6A and EP 310-1-6B. The sign shall be erected as soon as possible and within 15 days after the date of receipt of notice to proceed.

The data required by the sign shall be corrected daily, with light colored metallic or non-metallic numerals. Numerals, including mounting hardware, shall be subject to the approval of the Contracting Officer. Upon completion of the project, the sign shall be removed and disposed of by the Contractor. (CENAB)

## 1.7 TEMPORARY ELECTRICAL WORK: (APR 1962 REV JUL 2000)

Temporary electrical work shall be in accordance with Sections 7 and 11 of EM 385-1-1 U.S. Army Corps of Engineers Safety and Health Requirements Manual. The Contractor shall submit for approval a temporary power distribution sketch prior to the installation of any temporary power. The sketch shall include location, voltages, and means of protection for all temporary distribution system wiring and components to include lighting, receptacles, grounding, disconnecting means, and GFCIs. The Contractor shall test the temporary power system and devices for polarity, ground continuity, and ground resistance prior to the initial use and before use after any modification. The Contractor shall verify to the satisfaction of the Contracting Officer or his representative by a calibrated light meter that the minimum illumination required by Table 7-1 of the EM 385-1-1 is being provided. (CENAB-EN-DT)

## 1.8 AVAILABILITY AND USE OF UTILITY SERVICES

## 1.8.1 Sanitation

The Contractor shall provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer. Government toilet facilities will not be available to Contractor's personnel.

## 1.8.2 Telephone

The Contractor shall make arrangements and pay all costs for telephone facilities desired.

## 1.9 CONTRACTOR'S TEMPORARY FACILITIES

## 1.9.1 Administrative Field Offices

The Contractor shall provide and maintain administrative field office facilities within the construction area at the designated site. Government office and warehouse facilities will not be available to the Contractor's personnel.

## 1.9.2 Storage Area

The Contractor shall construct a temporary 6 foot high chain link fence around trailers and materials. The fence shall include plastic strip inserts, colored green, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the military boundaries. Trailers, equipment, or materials shall not be open to public view with the exception of those items which are in support of ongoing work on any given day. Materials shall not be stockpiled outside the fence in preparation for the next day's work. Mobile equipment, such as tractors, wheeled lifting equipment, cranes,

trucks, and like equipment, shall be parked within the fenced area at the end of each work day.

#### 1.9.3 Supplemental Storage Area

Upon Contractor's request, the Contracting Officer will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but shall be within the military boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor shall be responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

#### 1.9.4 Appearance of Trailers

Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers which, in the opinion of the Contracting Officer, require exterior painting or maintenance will not be allowed on the military property.

#### 1.9.5 Maintenance of Storage Area

Fencing shall be kept in a state of good repair and proper alignment. Should the Contractor elect to traverse, with construction equipment or other vehicles, grassed or unpaved areas which are not established roadways, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation shall be at the Contractor's discretion. Grass located within the boundaries of the construction site shall be mowed for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers shall be edged or trimmed neatly.

#### 1.10 TEMPORARY PAVING PATCH

The Contractor shall place a temporary patch of cold mixed asphalt of adequate size and thickness immediately after utility trenches or other road or paved area openings are backfilled and compacted as specified in DIVISION II. The temporary patch shall be maintained by the Contractor until he permanently repairs the opening as delineated in DIVISION II. (SUGG NO. 75-183)

#### 1.11 PLANT COMMUNICATION (JAN 63)

Whenever the Contractor has the individual elements of his plant so located that operation by normal voice between these elements is not satisfactory, the Contractor shall install a satisfactory means of communication, such as telephone or other suitable devices. The facilities shall be made available for use by Government personnel. (CENAB)

## 1.12 BARRICADES

The Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazardous areas during both day and night. (CENAB)

## 1.13 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

## 1.14 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

PART 2 PRODUCT  
NOT APPLICABLE

PART 3 EXECUTION  
NOT APPLICABLE

-- End of Section --

## SECTION 01562

ENVIRONMENTAL PROTECTION  
01/01

## PART 1 GENERAL

The work covered by this section consists of furnishing all labor, materials and equipment and performing all work required for the prevention of environmental pollution during and as the result of construction operations under this contract except for those measures set forth in other Technical Provisions of these specifications. For the purpose of this specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importances to human life or affect other species of importance to man. The control of environmental pollution requires consideration of air, water, and land.

## 1.1 APPLICABLE REGULATIONS

In order to prevent, and to provide for abatement and control of any environmental pollution arising from construction activities, the Contractor and his subcontractors in the performance of this contract, shall comply with all applicable Federal, State, and local laws, and regulations concerning environmental pollution control and abatement, and all applicable provisions of the Corps of Engineers Manual, EM 385-1-1, entitled "Safety and Health Requirements Manual" in effect on the date of solicitation as well as the specific requirements stated elsewhere in the contract specifications.

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Implementation; G AR.

Contractor's proposal to put into practice the environmental pollution control.

## 1.3 NOTIFICATION

The Contracting Officer will notify the Contractor in writing of any non-compliance with the foregoing provisions and the action to be taken.

The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient notification for the purpose. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it was later determined that the Contractor was in compliance.

#### 1.4 SUBCONTRACTORS

Compliance with the provisions of this section by subcontractors will be the responsibility of the Contractor.

#### 1.5 IMPLEMENTATION

Prior to commencement of the work the Contractor will:

##### 1.5.1 Approval

Submit in writing, for approval, his proposals for implementing this section for environmental pollution control;

##### 1.5.2 Environmental Pollution Control

Meet with the representatives of the Contracting Officer to develop mutual understanding relative to compliance with this provision and administration of the environmental pollution control program.

#### 1.6 PROTECTION OF WATER RESOURCES

The Contractor shall not pollute streams, lakes or reservoirs with fuels, oils, bitumens, calcium chloride, acid construction wastes or other harmful materials. It is the responsibility of the Contractor to investigate and comply with all applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams. All work under this contract shall be performed in such a manner that objectionable conditions will not be created in streams through or adjacent to the project areas.

#### 1.7 BURNING

Unless otherwise specified in other sections of the specifications, burning will be allowed only if authorized in writing by the Contracting Officer. However, the specific time, location and manner of burning shall be subject to the approval of the Contracting Officer. Fires shall be guarded at all times and shall be under constant surveillance until they have burned out or have been extinguished. All burning shall be so thorough that the materials will be reduced to ashes.



1.8 DUST CONTROL

The Contractor shall maintain all work areas free from dust which would contribute to air pollution. Approved temporary methods of stabilization consisting of sprinkling, chemical treatment, light bituminous treatment or similar methods will be permitted to control dust. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

1.9 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

During the life of this contract, the Contractor shall maintain all facilities constructed for pollution control under this contract as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

PART 2 PRODUCT  
NOT APPLICABLE

PART 3 EXECUTION  
NOT APPLICABLE

-- End of Section --

## SECTION 01572

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT  
07/00

## PART 1 GENERAL1.1 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy the Contractor shall: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

## 1.2 MANAGEMENT

The Contractor shall take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling shall accrue to the Contractor. Firms and facilities used for recycling, reuse, and disposal shall be appropriately permitted for the intended use to the extent required by federal, state, and local regulations.

## 1.3 PLAN

A waste management plan shall be submitted within 15 days after contract award and prior to initiating any site preparation work. The plan shall include the following:

- a. Name of individuals on the Contractor's staff responsible for waste prevention and management.
- b. Actions that will be taken to reduce solid waste generation.
- c. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas and equipment to be used for processing, sorting, and temporary storage of wastes.
- d. Characterization, including estimated types and quantities, of the waste to be generated.

- e. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.
- f. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity.
- g. List of specific waste materials that will be salvaged for resale, salvaged and reused, or recycled. Recycling facilities that will be used shall be identified.
- h. Identification of materials that cannot be recycled/reused with an explanation or justification.
- i. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

#### 1.4 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

#### 1.5 COLLECTION

The necessary containers, bins and storage areas to facilitate effective waste management shall be provided and shall be clearly and appropriately identified. Recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials and separated by one of the following methods:

##### 1.5.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted into appropriately marked separate containers and then transported to the respective recycling facility for further processing.

##### 1.5.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

##### 1.5.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the

Contracting Officer.

1.6 DISPOSAL

Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.6.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered. Salvaged materials, other than those specified in other sections to be salvaged and reinstalled, shall not be used in this project.

1.6.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling whenever economically feasible.

1.6.3 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

-- End of Section --

SECTION 01670

RECYCLED / RECOVERED MATERIALS

09/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Material
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1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

The items listed in Table 1 have been identified by EPA as being products which are proposed as possible designated items at some time in the future. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or

recovered materials providing specified requirements are also met.

**TABLE 1 EPA PROPOSED ITEMS**

<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
Carpet Backing	--		
Carpet Cushion	--		
Flowable Fill	--		
Railroad Grade			
Crossings/Surfaces	--		
Landscaping Timbers & Posts	Plastic		
Park and Recreational			
Furniture	--		
Playground Equipment	--		
Parking Stops	Plastic or Rubber	100	
	Fly Ash (concrete)	--	20-40
	Slag (concrete)	--	25-70
Signage	--		
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**1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK**

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials.

**EPA DESIGNATED ITEMS**

<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>BUILDING INSULATION</b>			
Rock Wool	Slag	--	75
Fiberglass	Glass Cullet	--	20-25
Cellulose Loose-Fill and Spray-On	Postconsumer Paper	75	75
Perlite Composite Board	Postconsumer Paper	23	23
Plastic Rigid Foam, Polyisocyanurate/ Polyurethane:			
Rigid Foam	--	--	9
Foam-in-Place	--	--	5
Glass Fiber Reinforced	--	--	6
Phenolic Rigid Foam	--	--	5
Plastic, Non-Woven Batt	Recovered or Postconsumer Plastics	--	100

**NOTES:** 1. Recovered materials content levels are based on the weight (not volume) of materials in the insulation core only.

2. Glass cullet in fiberglass insulation shall conform to ASTM D5359.

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<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>CARPET</b>			
Polyester Carpet Face Fiber	PET	25-100	25-100

NOTES: 1. PET is recovered soda bottles.

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<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>CEMENT AND CONCRETE</b>			
Concrete	Coal Fly Ash	--	*As Specified

Blast Furnace Slag -- \*As Specified

\* Content depends upon the design -  
See Section 03300

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<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>REPROCESSED AND CONSOLIDATED LATEX PAINTS</b>			
Reprocessed Latex Paint			
White, off-white			
Pastel Colors		20	20
Grey, brown, earthtones			
and other dark colors		50-99	50-99
Consolidated Latex Paint		100	100

NOTE: Percentages apply to reprocessed latex paints used for interior and exterior architectural applications such as wallboard, ceilings, and trim; gutter boards; and concrete, stucco, masonry, wood, and metal surfaces. Percentages apply to consolidated latex paints used for covering graffiti, where color and consistency of performance are not primary concerns.

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<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>FLOOR TILES AND PATIO BLOCKS</b>			
Floor tiles (heavy duty/commercial use)	Rubber	90-100	
	Plastic		90-100
Patio Blocks	Rubber or		
	Rubber blends	90-100	
	Plastic or		
	Plastic Blends		90-100

NOTES: 1. Content levels are based on the dry weight of the raw materials, exclusive of any additives such as adhesives, binders, or coloring agents.

2. The use of floor tiles with recovered materials content might be appropriate only for specialty purpose uses (e.g., raised, open-web files for drainage on school kitchen flooring).

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<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>TOILET DIVIDERS AND PARTITIONS</b>			
Toilet dividers and partitions	Steel	16	20-30
	Plastic	20-100	20-100



<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>FIBERBOARD / PAPERBOARD</b>			
Structural fiberboard			80-100
Paminated paperboard	Post Consumer paper	100	100

NOTES: 1. Content levels are based on the weight (not volume) of materials in the insulating core only.

2. Structural fiberboard containing recovered paper shall conform to ASTM C 208.

<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>HYDRAULIC MULCH</b>			
Paper based hydr. mulch	Paper	100	100
Wood based hydr. mulch	Wood and Paper		100

NOTE: Content levels are based on the dry weight of the fiber, exclusive of any dyes, wetting agents, seeds, fertilizer, or other non-cellulose additives.

<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>LAWN &amp; GARDEN EDGING</b>			
Lawn and garden edging	Plastic and/or rubber	30-100	30-100

<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>PLASTIC FENCING</b>			
Plastic fencing	Plastic	60-100	90-100

NOTE: Designation includes fencing for use in controlling snow or sand drifting and as a warning/safety barrier in construction or other applications.

<u>PRODUCT</u>	<u>MATERIAL</u>	<u>POSTCONSUMER CONTENT (%)</u>	<u>RECOVERED MATERIALS CONTENT (%)</u>
<b>PLAYGROUND / RUNNING TRACK SURFACING</b>			
Playground/Running Track Surfacing	Rubber or Plastic	90-100	

NOTE: 1. Content levels are based on the dry weight of the raw materials,

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exclusive of any additives such as adhesives, binders, or coloring agents.

2. Playground surfaces shall conform to the requiremets of ASTM F 1292.

3. Playground surfacing shall comply with the Americans with  
Disabilites Disabilities Act.

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-- End of Section --

## SECTION 01720

AS-BUILT DRAWINGS - CADD  
**04/02**

## PART 1 GENERAL

## 1.1 Preparation

This section covers the preparation of as-built drawings complete, as a requirement of this contract. The terms "drawings," "contract drawings," "drawing files," and "final as-built drawings" refer to a set of computer-aided design and drafting (CADD) contract drawings in electronic file format which are to be used for as-built drawings.

## 1.2 PROGRESS MARKED UP AS-BUILT PRINTS

The Contractor shall revise one set of paper prints to show the as-built conditions during the prosecution of the project. These as-built marked prints shall be kept current and available on the jobsite at all times. All changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. The as-built marked prints will be jointly reviewed for accuracy and completeness by the Contracting Officer and a responsible representative of the construction Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the as-built drawings as specified herein, the Contracting Officer will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the as-built drawings and will continue the monthly deduction of the 10% retainage even after 50% completion of the contract. This monthly deduction will continue until an agreement can be reached between the Contracting Officer and a representative of the Contractor regarding the accuracy and completeness of updated drawings. The prints shall show the following information, but not be limited thereto:

## 1.2.1 Location and Description

The location and description of any utility lines or other installations of any kind or description known to exist within the construction area. The location includes dimensions to permanent features.

## 1.2.2 Location and Dimensions

The location and dimensions of any changes within the building or structure.

## 1.2.3 Corrections

Correct grade, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

Correct elevations if changes were made in site grading.

#### 1.2.4 Changes

Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

The topography, invert elevations and grades of all drainage installed or affected as a part of the project construction.

All changes or modifications which result from the final inspection.

#### 1.2.5 Options

Where contract drawings or specifications present options, only the option selected for construction shall be shown on the as-built prints.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-11 Closeout Submittals

Progress Prints; G AR.

Preparation of two copies of as-builts from the Contractor to the Contracting Officer for review and approval.

Final Requirements; G AR.

CADD Files.

Shall consist of two sets of completed as-built contract drawings on separate media consisting of both CADD files (compatible with the Using Agency/Sponsor's system on electronic storage media identical to that supplied by the Government) and a CALS Type 1, Group 4, Raster Image File of each contract drawing.

Receipt by the Contractor of the approved marked as-built prints.

#### 1.4 PRELIMINARY SUBMITTAL

At the time of final inspection, the Contractor shall prepare two copies of the progress as-built prints and these shall be delivered to the Contracting Officer for review and approval. These as-built marked prints shall be neat, legible and accurate. The review by Government personnel will be expedited to the maximum extent possible. Upon approval, one copy

of the as-built marked prints will be returned to the Contractor for use in preparation of final as-built drawings. If upon review, the as-built marked prints are found to contain errors and/or omissions, they shall be returned to the Contractor for corrections. The Contractor shall complete the corrections and return the as-built marked prints to the Contracting Officer within ten (10) calendar days.

#### 1.5 DRAWING PREPARATION

##### 1.5.1 As-Built Drawings Approval

Upon approval of the as-built prints submitted, the Contractor will be furnished by the Government one set of contract drawings, with all amendments incorporated, to be used for as-built drawings. These contract drawings will be furnished on CD-ROM. These drawings shall be modified as may be necessary to correctly show all the features of the project as it has been constructed by bringing the contract set into agreement with the approved as-built prints, adding such additional drawings as may be necessary. These drawings are part of the permanent records of this project and the Contractor shall be responsible for the protection and safety thereof until returned to the Contracting Officer. Any drawings damaged or lost by the Contractor shall be satisfactorily replaced by the Contractor at no expense to the Government.

##### 1.5.2 Proficient Personnel

Only personnel proficient in the preparation of engineering CADD drawings to standards satisfactory and acceptable to the Government shall be employed to modify the contract drawings or prepare additional new drawings. All additions and corrections to the contract drawings shall be equal in quality to that of the originals. Line work, line weights, lettering, layering conventions, and symbols shall be the same as the original line work, line weights, lettering, layering conventions, and symbols. If additional drawings are required, they shall be prepared using the specified electronic file format applying the same guidance specified for original drawings. The title block and drawing border to be used for any new as-built drawings shall be identical to that used on the contract drawings. All additions and corrections to the contract drawings shall be accomplished using CADD media files supplied by the Government. These contract drawings will already be compatible with the Using Agency/Sponsor's system when received by the Contractor. The Using Agency/Sponsor uses AutoCAD Release 2000 CADD software system. The media files will be supplied on ISO 9660 Format CD-ROM. The Contractor is responsible for providing all program files and hardware necessary to prepare as-built drawings. The Contracting Officer will review all as-built drawings for accuracy and the Contractor shall make all required corrections, changes, additions, and deletions.

##### 1.5.3 Final Revisions

When final revisions have been completed, the cover sheet drawing shall show the wording "RECORD DRAWING AS-BUILT" followed by the name of the General Contractor in letters at least 3/16 inch high. All other contract drawings shall be marked either "As-Built" drawing denoting no revisions on

the sheet or "Revised As-Built" denoting one or more revisions. All original contract drawings shall be dated in the revision block (SEE ATTACHMENT 1 at the end of this section - while the title block sample attachments do not depict the contract drawings' title blocks, the sample revision blocks above these attachments are to be used as guidance in completing the actual contract drawings' revision blocks.)

#### 1.6 FINAL REQUIREMENTS

After receipt by the Contractor of the approved marked as-built prints and the original contract drawing files the Contractor will, within 30 days for contracts less than \$5 million or 60 days for contracts \$5 million and above, make the final as-built submittal. The submittal shall consist of the following:

a) Two sets of the as-built contract drawings on separate CD's (ISO 9660 Format CD-ROM) consisting of the updated CADD files and a CALS Type 1 Group 4 Raster Image File of each contract drawing plate. The CALS files shall be exact duplicates of the full sized plots of the completed as-built contract drawings at a resolution of 400 dpi and may be either plotted to CALS files directly from the CADD files, or scanned to file from the prints.

b) Two sets of full size paper prints (plots) of the completed as-built contract drawings.

c) The return of the approved marked as-built prints.

They shall be complete in all details and identical in form and function to the contract drawing files supplied by the Government. Any translations or adjustments necessary to accomplish this is the responsibility of the Contractor. The Government reserves the right to reject any drawing files it deems incompatible with its CADD system. All paper prints, drawing files and storage media submitted will become the property of the Government upon final approval. Failure to submit as-built drawing files and marked prints as required herein shall be cause for withholding any payment due the Contractor under this contract. Approval and acceptance of final as-built drawings shall be accomplished before final payment is made to the Contractor.

#### 1.7 PAYMENT

No separate payment will be made for the as-built drawings required under this contract, and all costs in connection therewith shall be considered a subsidiary obligation of the Contractor.

PART 2 PRODUCT  
NOT APPLICABLE

PART 3 EXECUTION  
NOT APPLICABLE

-- End of Section --





SECTION 02220

DEMOLITION  
09/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI Guideline K (1997) Containers for Recovered  
Fluorocarbon Refrigerants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6 (1990; R 1998) Safety Requirements for  
Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (1996) Safety and Health Requirements  
Manual

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25 (June 2000) Storage and Handling of  
Liquefied and Gaseous Compressed Gases and  
Their Full and Empty Cylinders

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M Requisitioning and Issue Procedures

MIL-STD-129 (Rev. P) Military Marking for Shipment and  
Storage

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61-SUBPART M National Emission Standard for Asbestos

40 CFR 82 Protection of Stratospheric Ozone

49 CFR 173.301 Shipment of Compressed Gases in Cylinders  
and Spherical Pressure Vessels

## 1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the building. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible. Salvaged items and materials shall be disposed of as specified.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

Submit proposed salvage, demolition and removal procedures to the Contracting Officer for approval before work is started.

## 1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," safety requirements shall conform with ANSI A10.6.

### 1.4.1 Notifications

#### 1.4.1.1 General Requirements

Furnish timely notification of demolition and renovation projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61-SUBPART M. Notify the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61-SUBPART M.

## 1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area daily. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to aircraft.

## 1.6 PROTECTION

### 1.6.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement. Notify the Contracting Officer prior to beginning such work.

### 1.6.2 Existing Work

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements and pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Contracting Officer approval.

### 1.6.3 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent displacement.

### 1.6.4 Trees

Trees within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 6 foot high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

### 1.6.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional

bracing, shoring, or lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

#### 1.6.6 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

#### 1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

#### 1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by the Contracting Officer.

#### 1.9 ENVIRONMENTAL PROTECTION

The work shall comply with the requirements of Section 01562 ENVIRONMENTAL PROTECTION.

#### 1.10 USE OF EXPLOSIVES

Use of explosives will not be permitted.

#### PART 2 PRODUCTS

Not used.

#### PART 3 EXECUTION

##### 3.1 EXISTING FACILITIES TO BE REMOVED

###### 3.1.1 Structures

Existing structures indicated shall be removed to 2 feet below grade.

###### 3.1.2 Utilities and Related Equipment

Remove existing utilities uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility

and approved by the Contracting Officer. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer.

#### 3.1.3 Paving and Slabs

Remove asphaltic concrete paving. Provide neat sawcuts at limits of pavement removal for the proposed equipment foundations as shown on structural drawings.

#### 3.1.4 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

- a. Holes and depressions caused by previous physical damage or left as a result of removals in existing masonry walls to remain shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.
- b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.
- c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

#### 3.1.5 Air Conditioning Equipment

Remove air conditioning equipment without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning equipment and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

#### 3.1.6 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

### 3.1.7 Locksets on Swinging Doors

The Contractor shall remove all locksets from all swinging doors indicated to be removed and disposed of. Contractor shall give the locksets to the Contracting Officer after their removal.

### 3.2 FILLING

Holes, open basements and other hazardous openings shall be filled as shown on the plan or as directed by the Contracting Officer.

### 3.3 DISPOSITION OF MATERIAL

#### 3.3.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award.

Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

#### 3.3.2 Salvaged Materials and Equipment

Contractor shall salvage items and material to the maximum extent possible.

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents.

Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in as directed by the Contracting Officer by shipping the refrigerant container to the Defense Logistics Agency at the following address:

Defense Depot Richmond VA (DDVA)  
SW0400  
Cylinder Operations  
800 Jefferson Davis Highway  
Richmond, VA 23297-5000

### 3.3.3 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting ARI Guideline K suitable for the type ODS filled to no more than 80 percent capacity and provide appropriate labeling. Recovered ODS shall be removed from Government property and dispose of in accordance with 40 CFR 82. Products, equipment and appliances containing ODS in a sealed, self-contained system shall be disposed of in accordance with 40 CFR 82.

#### 3.3.3.1 Special Instructions

Each container shall have in it no more than one type of ODS. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

- a. Activity name and unit identification code
- b. Activity point of contact and phone number
- c. Type of ODS and pounds of ODS contained
- d. Date of shipment

#### 3.3.3.2 Fire Suppression Containers

Fire suppression system cylinders and canisters with electrical charges or initiators shall be deactivated prior to shipment. Also, safety caps shall be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

### 3.3.4 Transportation Guidance

Shipment of all ODS containers shall be in accordance with Army Regulation 700-68.

### 3.3.5 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of off the base.

## 3.4 CLEANUP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

### 3.4.1 Debris and Rubbish

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage

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on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

-- End of Section --



## SECTION 02300

EARTHWORK  
08/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO T 180 (2001) Moisture-Density Relations of Soils  
Using a 4.54-kg (10-lb) Rammer and an  
457-mm (18-in) Drop

AASHTO T 224 (2001) Correction for Coarse Particles in  
the Soil Compaction Test

## AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C600 (1999) Installation of Ductile-Iron Water  
Mains and Their Appurtenances

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2002) Structural Welding Code - Steel

## AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2 (2001) Lumber, Timber, Bridge Ties and  
Mine Ties - Preservative Treatment by  
Pressure Processes

AWPA P5 (2002) Standard for Waterborne  
Preservatives

## ASTM INTERNATIONAL (ASTM)

ASTM C 136 (2001) Sieve Analysis of Fine and Coarse  
Aggregates

ASTM C 33 (2003) Concrete Aggregates

ASTM D 1140 (2000) Amount of Material in Soils Finer  
than the No. 200 (75-micrometer) Sieve

ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1883	(1999) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2434	(1968; R 2000) Permeability of Granular Soils (Constant Head)
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(2000e1) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 3017	(2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 698	(2000a) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

## U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(1996) Safety and Health Requirements Manual
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## U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	(1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-203

(Rev. C; Notice 2) Paper, Kraft, Untreated

## 1.2 DEFINITIONS

## 1.2.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP. Satisfactory materials for grading shall be comprised of stones less than 8 inches, except for fill material for pavements and railroads which shall be comprised of stones less than 3 inches in any dimension.

## 1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.

## 1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

## 1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve shall be expressed as a percentage of the maximum density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224. To maintain the same percentage of coarse material, the "remove and replace" procedure as described in the NOTE 8 in Paragraph 7.2 of AASHTO T 180 shall be used.

## 1.2.5 Topsoil

Material suitable for topsoils obtained from excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

#### 1.2.6 Hard/Unyielding Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

#### 1.2.7 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

#### 1.2.8 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

#### 1.2.9 Select Granular Material

##### 1.2.9.1 General Requirements

Select granular material shall consist of materials classified as GW, GP, SW, or SP, by ASTM D 2487 where indicated. The liquid limit of such material shall not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index shall not be greater than 12 percent when tested in accordance with ASTM D 4318, and not more than 35 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D 1140. Coefficient of permeability shall be a minimum of 0.002 feet per minute when tested in accordance with ASTM D 2434.

#### 1.2.10 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 2 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 1 1/2 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

#### 1.2.11 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than five when tested in accordance with ASTM D 4318.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-03 Product Data

Utilization of Excavated Materials; G, A/E  
Rock Excavation  
Opening of any Excavation or Borrow Pit

Procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

#### SD-06 Test Reports

Testing  
Borrow Site Testing

Within 24 hours of conclusion of physical tests, 3 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

#### SD-07 Certificates

Testing  
  
Qualifications of the commercial testing laboratory or Contractor's testing facilities.

### 1.4 SUBSURFACE DATA

No subsurface soil borings were taking for this project.

### 1.5 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

#### 1.5.1 Common Excavation

Common excavation shall include the satisfactory removal and disposal of all materials.

## 1.5.2 BLASTING

Blasting will not be permitted.

## 1.6 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.
- b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

## PART 2 PRODUCTS

## 2.1 REQUIREMENTS FOR OFFSITE SOILS

Offsite soils brought in for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the Contracting Officer.

## 2.2 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

## Warning Tape Color Codes

Yellow:	Electric
Blue:	Water Systems
Green:	Sewer Systems

## 2.2.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi

lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

#### 2.2.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

#### 2.3 CAPILLARY WATER BARRIER

Capillary Water Barrier shall consist of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Fine aggregate grading shall conform to ASTM C 33 with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve, or 1-1/2 inches and no more than 2 percent by weight passing the No. 4 size sieve or coarse aggregate Size 57, 67, or 77.

### PART 3 EXECUTION

#### 3.1 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped to a depth of 6 inches. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

#### 3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas.

During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation

within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

#### 3.2.1 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

#### 3.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 2 feet below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system. Relieve hydrostatic head in previous zones below subgrade elevation in layered soils to prevent uplift.

#### 3.2.3 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 4 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 4 feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench



width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

#### 3.2.3.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 2 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

#### 3.2.3.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 6 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

#### 3.2.3.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

#### 3.2.3.4 Excavation for Appurtenances

Excavation for tie-in at the existing manhole and tap for the water line shall leave at least a sufficient clearance to permit tie-in of the replacement of the sewer line and installation of the water line tap and thrust block. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete is to be placed.

#### 3.2.4 Underground Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by

hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

#### 3.2.5 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement.

### 3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling.

### 3.4 SHORING

#### 3.4.1 General Requirements

The Contractor shall submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

#### 3.4.2 Geotechnical Engineer

The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with the Contracting Officer at any time throughout the contract duration.

### 3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and

required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Stockpiles of satisfactory, unsatisfactory and wasted materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources.

### 3.6 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Only excavation methods that will leave the foundation rock in a solid and unshattered condition shall be used. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond. Shales shall be protected from slaking and all surfaces shall be protected from erosion resulting from ponding or flow of water.

### 3.7 GROUND SURFACE PREPARATION

#### 3.7.1 General Requirements

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

#### 3.7.2 Frozen Material

Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to plus or minus 2 percent of optimum moisture to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph TESTING.

### 3.8 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of in

designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

### 3.9 BURIED TAPE

#### 3.9.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

### 3.10 BACKFILLING AND COMPACTION

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph GROUND SURFACE PREPARATION. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs GROUND SURFACE PREPARATION and SUBGRADE PREPARATION, and Section 02300 EARTHWORK. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

#### 3.10.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to one foot above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

##### 3.10.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

##### 3.10.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6

inches loose thickness.

#### 3.10.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:

- a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
- b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.
- c. Clean, coarse-grained sand classified as SW or SP by ASTM D 2487 for bedding and backfill as indicated.
- d. Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as GW and GP in accordance with ASTM D 2487 for bedding and backfill as indicated. Maximum particle size shall not exceed 2 inches.

#### 3.10.1.4 Final Backfill

The remainder of the trench, except for special materials for slabs on grade shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

- a. Slabs on Grade: Backfill shall be placed up to the required elevation as specified. Water flooding or jetting methods of compaction will not be permitted.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

#### 3.10.2 Backfill for Appurtenances

After the manhole, tie-in and water line tap have been constructed and the

concrete has been allowed to cure for 7 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

### 3.11 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

#### 3.11.1 Water Lines

Trenches shall be of a depth to provide a minimum cover of 3.5 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

### 3.12 SUBGRADE PREPARATION

#### 3.12.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of the slabs on grade with six passes of a dump truck loaded with 4 cubic yards of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 mph. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material shall be undercut as directed by the Contracting Officer replaced with select material. Bids shall be based on replacing approximately 120 square yards, with an average depth of 12 inches at various locations.

#### 3.12.2 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 6 inches below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1 inch when tested with a 10 foot straightedge applied both parallel and at right angles to the centerline of the area.

#### 3.12.3 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired

rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, each layer of the fill shall be compacted to at least 90 percent of laboratory maximum density.

### 3.13 FINISHING

The surface of excavations and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials. Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades re-established to the required elevations and slopes.

#### 3.13.1 Subgrade

During construction and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or slab is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, ballast, or slab shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be placed on a muddy, spongy, or frozen subgrade.

#### 3.13.2 Grading Around Structures

Areas within 5 feet outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

### 3.14 PLACING TOPSOIL

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 2 inch depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 4 inches and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from offsite areas.

### 3.15 TESTING

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. Field in-place density shall be determined in

accordance with ASTM D 1556 and ASTM D 2937, Drive Cylinder Method shall be used only for soft, fine-grained, cohesive soils. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompact to meet specification requirements. Tests on recompact areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

#### 3.15.1 Fill and Backfill Material Gradation

One test per 100 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136.

#### 3.15.2 In-Place Densities

- a. One test per 2,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.
- b. One test per 1,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

#### 3.15.3 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

#### 3.15.4 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 50 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

#### 3.15.5 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

#### 3.15.6 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 2 feet above the top of the pipe, the pipe shall be inspected



to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

### 3.16 DISPOSITION OF SURPLUS MATERIAL

Surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber shall be removed from Government property as directed by the Contracting Officer.

-- End of Section --

## SECTION 02555A

PREFABRICATED UNDERGROUND HEATING/COOLING DISTRIBUTION SYSTEM  
**12/01**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 105/A 105M	(2001) Carbon Steel Forgings for Piping Applications
ASTM A 106	(1999e1) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 234/A 234M	(2000) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1999) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM D 1384	(1997a) Corrosion Test for Engine Coolants in Glassware

ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 2241	(2000) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(2000) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 5686	(1995) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Pipe Fittings, Adhesive Bonded Joint Type Epoxy Resin, for Condensate Return Line
ASTM F 477	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

## AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints
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## ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(1998) Power Piping

ASME BPVC SEC IX (1998) Boiler and Pressure Vessel Code;  
Section IX, Welding and Brazing  
Qualifications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015 (1995) Copper Tube Handbook

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-73 (1991; R 1996) Brazing Joints for Copper  
and Copper Alloy Pressure Fittings

## 1.2 SYSTEM DESCRIPTION

The system consists of a buried prefabricated chilled water and low temperature hot water dual temperature distribution system including service connections to a point 6 inches inside of the building. The contract drawings show the specific arrangement of piping, sizes and grades of pipe, and other details. The system is designed for an operating pressure of 150 psig and an operating temperature of 45 degrees F for chilled water.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Distribution System; G

Detail drawings consisting of fabrication and assembly drawings, for all parts of the work in sufficient detail to check conformity with the requirements of the contract documents, prior to installation. Detail drawings shall also contain complete piping, wiring and schematic diagrams and any other details to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout, method of compensation for pipe expansion and contraction, anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances required for maintenance and operation. The drawings shall clearly identify any proposed deviations from the requirements of the contract documents.

### SD-03 Product Data

Distribution System;

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

#### SD-07 Certificates

##### Distribution System;

The manufacturer's or system fabricator's written certification stating that the distribution system furnished meets all the requirements of this specification.

##### Welding; G

Prior to welding operations, a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

#### SD-10 Operation and Maintenance Data

##### Distribution System; G

Six copies of operation and 6 copies of maintenance manuals for the equipment furnished, 1 complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for equipment startup, operation, and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the equipment system as installed. Manuals shall be approved prior to the field performance testing.

### 1.4 DELIVERY AND STORAGE

After delivery to the jobsite, all materials and equipment shall be protected from anything which could cause damage to the material or equipment. Pipe shall be sealed at each end to keep the interior clean and free of dirt and debris. Fittings shall be kept together and their interior surfaces shall remain clean. Insulation shall be kept dry and clean.

### 1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

## 1.6 WELDING

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

System components shall be standard products of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The system shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

### 2.2 PIPING AND CASING MATERIALS

#### 2.2.1 General

Metallic pressure pipe, fittings, and piping accessories shall conform to the requirements of ASME B31.1 and shall be types suitable for the temperature and pressure of the water.

#### 2.2.2 Piping

##### 2.2.2.1 Steel Pipe

Piping shall conform to ASTM A 53/A 53M, Grade B, standard weight, black or to ASTM A 106, Grade B, standard weight.

##### 2.2.2.2 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K or L.

##### 2.2.2.3 Reinforced Thermosetting Resin Pipe (RTRP)

RTRP pipe shall conform to ASTM D 5686.

##### 2.2.2.4 Polyvinyl Chloride (PVC) Pipe

PVC pipe shall conform to ASTM D 2241 with a Standard Thermoplastic Pipe Dimension Ratio (SDR) of 26 and PVC 1120 or 1220 as the material.

## 2.2.2.5 Joints and Fittings for Copper Tubing

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 230 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183.

## 2.2.3 Casings

## 2.2.3.1 Polyvinyl Chloride (PVC) Casing

PVC casings shall conform to ASTM D 1784, Class 12454-B with a minimum thickness equal to the greater of 1/100 the diameter of the casing or 60 mils.

## 2.2.3.2 Polyethylene (PE) Casing

Polyethylene casings shall conform to ASTM D 3350, Type III, Class C, Category 3 or 4, Grade P 34 with thickness as follows:

Casing Diameter (in inches)	Minimum Thickness (in mils)
10 and smaller	125
10 to 18	150
18 through 24	200
over 24	225

## 2.2.3.3 Reinforced Thermosetting Resin Pipe (RTRP) Casing

RTRP casing shall be of the same material as the pipe, with casing thickness as follows:

Casing Diameter (in inches)	Minimum Thickness (in mils)
8 and smaller	70
10	80
12	105
14	115
16 to 18	120
20	125
24	155

Casing Diameter  
(in inches)

Minimum Thickness  
(in mils)

## 2.3 PIPING CONNECTIONS

### 2.3.1 Steel Pipe

Steel pipe smaller than 3/4 inch may be threaded; otherwise, all steel pipe shall be welded. Steel welding fittings shall conform to the requirements of ASTM A 105/A 105M or ASTM A 234/A 234M. Welding fittings shall also conform to ASME B16.9 for butt-weld fittings and ASME B16.11 for socket-weld fittings. Long radius butt-welding elbows conforming to ASME B16.9 shall be used whenever space permits. Pipe Threads shall conform to ASME B1.20.1. Pipe to be threaded shall be schedule 80.

### 2.3.2 Copper Pipe

Copper pipe shall be brazed or connected using an insulated pipe coupling. Wrought copper or cast copper alloy solder joint pressure fittings shall conform to MSS SP-73. Insulated pipe couplings for copper pipe shall be cast bronze containing an O-ring seal on each end and shall be jacketed and sealed to act as an expansion joint.

### 2.3.3 Plastic Pipe

- a. Pipe, fittings, flanges, and couplings shall have end connections of the adhesive bell and spigot type. Threaded piping, including pipe, fittings, flanges, and couplings, will not be permitted.
- b. Flanged Connections: Flat face flanged connections shall be provided between plastic piping and metal piping. Plastic flanges shall be suitable for connection to ASME Class 150 flanges.
- c. RTRP Piping Sizes: When piping sizes other than 2, 3, 4, 6, and 8 inches are indicated, the next larger piping size shall be provided. The connecting system piping shall be of the same size or increased to meet the next size of RTRP piping.

#### 2.3.3.1 General

Plastic fittings shall be made of the same type and grade of material as the piping to which they will be connected and shall be furnished by the manufacturer who supplies the pipe. Fittings shall have temperature and pressure ratings not less than those of the connecting piping.

#### 2.3.3.2 Polyvinyl Chloride (PVC)

Polyvinyl chloride (PVC) pipe shall be solvent welded or connected using bell and spigot connections. The solvent used to connect fittings and pipe shall conform to the requirements of ASTM D 2564. Bell and spigot joints utilizing elastomeric seals shall conform to the requirements of ASTM D 3139. The elastomeric seals shall conform to ASTM F 477.



## 2.3.3.3 Reinforced Thermosetting Resin Plastic (RTRP)

Reinforced thermosetting resin plastic pipe shall be joined using fittings and adhesive furnished by the pipe manufacturer in accordance with ASTM D 5686.

## 2.4 END SEALS

## 2.4.1 General

Each preinsulated section of piping shall have a complete sealing of the insulation to provide a permanent water and vapor seal at each end of the preinsulated section of piping. Preinsulated sections of piping modified in the field shall be provided with an end seal which is equivalent to the end seals furnished with the preinsulated section of piping. End seals must be tested and certified in accordance with paragraph Casing and End Seal Testing and Certification.

## 2.4.2 Types

End seals provided shall be one of the following types:

- a. Carrying the outer casing over tapered pipe insulation ends and extending it to the carrier pipe. Sufficient surface bonding area shall be provided between the casing and the carrier pipe.
- b. Using specially designed molded caps made of polyethylene or rubber of standard manufactured thickness. A minimum 1-1/2 inch surface bonding area shall be provided between the cap and both the casing and carrier pipe.
- c. Using elastomer-ring end seals designed and dimensioned to fit in the annular space between the casing and the carrier pipe.
- d. Using a waterproof mastic seal vapor barrier over the exposed insulation ends.
- e. Shrink sleeves.

## 2.4.3 Casing and End Seal Testing and Certification

Testing and certification procedures by an independent testing laboratory shall demonstrate that casings and end seals are capable of resisting penetration of water into the casing and insulation. The test shall be performed on the type of prefabricated system to be furnished. If more than one type of prefabricated system is to be used, then the tests shall be performed on each type. The test shall consist of hot and cold cycle testing followed by immersion in a water filled chamber with a head pressure. The hot and cold cycle testing shall consist of 14 days of temperature cycling. A fluid with a temperature of 40 degrees F shall circulate through the carrier pipe alternating every 24-hours with a fluid with a temperature of 200 degrees F circulating through the carrier pipe for a low temperature hot water or dual temperature service or 75 degrees F for a chilled water service. While the hot and cold cycle test is being

performed, the test sample is either buried or encased in dry bedding sand with a minimum of 12 inches of sand all around the test sample. The carrier pipe size of the test sample shall be 3 inches in diameter and shall be restrained during the test period. The insulation thickness shall not exceed the maximum thickness provided for the piping in the project. Transition time for temperature cycle testing shall not exceed 15 minutes in going from cold to hot and 30 minutes in going from hot to cold. The fluid in the carrier pipe may be water, oil or heat transfer fluid. Following the hot and cold cycling test, the test sample shall be immersed in a water filled chamber. The pressure on the highest point of the test sample shall not be less than 20 feet of water head pressure subjected over the entire length of the 8 foot test sample of prefabricated pipe. The water shall contain a dye penetrant, which will be used to check for end seal leakage. The pressure in the chamber must be held for not less than 48 hours. Upon completion of this pressure test, the test sample shall be cut open. With the use of a light that will readily show the presence of the dye that was in the water, the test sample shall be inspected. Evidence of the dye inside the test sample shall indicate that the end seal is not acceptable and cannot be certified.

## 2.5 INSULATION

The Contractor shall comply with EPA requirements in accordance with Section 01670A RECYCLED / RECOVERED MATERIALS.

### 2.5.1 Factory Applied Insulation

Prefabricated pipe and fittings shall be insulated in the factory. Foam insulation for prefabricated insulated pipe and fittings shall be polyurethane foam meeting the requirements of ASTM C 591 having a density not less than 2 pounds per cubic foot (pcf). The polyurethane foam shall completely fill the annular space between the carrier pipe and the casing. Insulation thickness shall be a minimum of 0.9 inches. The insulation thermal conductivity factor shall not exceed the numerical value of 0.15 Btu-inch/square foot-degree F-hour at 75 degrees F, when tested in accordance with ASTM C 518. Manufacturer shall certify that the insulated pipe is free of insulation voids.

### 2.5.2 Field Applied Insulation

Field applied insulation for fittings, and field casing closures, if required, and other piping system accessories shall be polyurethane matching the pipe insulation. Thickness shall match adjacent piping insulation thickness. Buried fittings and accessories shall have field applied polyurethane insulation to match adjacent piping and shall be protected with a covering matching the pipe casing. Shrink sleeves with a minimum thickness of 50 mils shall be provided over casing connection joints.

## 2.6 CONCRETE VALVE MANHOLES

Concrete valve manholes shall be provided in accordance with Section 02570A VALVE MANHOLES AND PIPING AND EQUIPMENT IN VALVE MANHOLES.

## 2.7 PIPING AND EQUIPMENT IN VALVE MANHOLES

Piping and equipment in valve manholes shall be provided in accordance with Section 02570A VALVE MANHOLES AND PIPING AND EQUIPMENT IN VALVE MANHOLES.

## 2.8 TREATED WATER

A 40 percent concentration by volume of industrial grade propylene glycol shall be provided for the system. Glycol shall be tested in accordance with ASTM D 1384 with less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicate based inhibitors shall not be used. The solution shall be compatible with pump seals, other elements of the system, and water treatment chemicals used within the system.

# PART 3 EXECUTION

## 3.1 INSTALLATION

For all preinsulated, prefabricated systems, the Contractor shall obtain the services of a trained representative of the pipe system manufacturer to instruct the Contractor's work forces in the installation procedures to ensure that the system is installed in accordance with the manufacturer's published instructions and the plans and specifications. The manufacturer's representative shall be a person who regularly performs such duties for the manufacturer. The Contractor shall furnish the Contracting Officer a list of names of personnel trained and certified by the pipe system manufacturer in the installation of this system. Only personnel whose names appear on the list will be allowed to install the system. The list shall not be more than 1 year old.

## 3.2 PIPING SYSTEMS

### 3.2.1 Buried Insulated Systems

Buried insulated systems shall consist of carrier pipe, insulation, casing, end seals, fittings and accessories as specified.

### 3.2.2 Buried Uninsulated Systems

Buried uninsulated systems shall consist of carrier pipe, fittings and accessories as specified.

## 3.3 VALVE MANHOLES AND PIPING EQUIPMENT IN VALVE MANHOLES

Valve manholes and piping and equipment in valve manholes shall be installed in accordance with Section 02570A VALVE MANHOLES AND PIPING AND EQUIPMENT IN VALVE MANHOLES.

## 3.4 THRUST BLOCKS

Thrust blocks shall be installed at the locations shown or recommended by the pipe system manufacturer. Thrust blocks may not be required on all systems, and the need for thrust blocks shall be as recommended by the

system manufacturer. Thrust blocks, if necessary, shall be installed at all changes in direction, changes in size, valves and terminal ends, such as plugs, caps and tees. Thrust blocks shall be concrete having a compressive strength of not less than 2000 psi after 28 days and shall be in accordance with Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Thrust blocks shall be placed between solid ground and the fitting to be anchored.

Unless otherwise indicated or directed, the base and the thrust bearing sides of the thrust blocks shall be poured directly against undisturbed earth. The sides of the thrust blocks not subject to thrust may be poured against forms. Thrust blocks shall be placed so that the joints for all fittings will be accessible for repair wherever possible. No pipe joint shall be embedded in concrete unless the assembly has previously been hydrostatically tested. The thrust blocks shall provide for transfer of thrusts and reactions without exceeding the allowable stress of the concrete and shall be installed in accordance with pipe manufacturer's instructions. In muck or peat, all thrusts shall be resisted by piles or tie rods to solid foundations or by removal of peat or muck which shall be replaced with ballast of sufficient stability to resist thrusts.

### 3.5 INSTALLATION OF PIPING SYSTEMS

The piping system furnished shall be installed in accordance with the piping system manufacturer's instructions. Piping shall be installed without springing or forcing other than what has been calculated for cold spring. Pipe ends shall have burrs removed by reaming and shall be installed to permit free expansion and contraction without damage to joints or hangers. Nonmetallic pipe cut in the field shall be machined to fit couplings or joints and shall be coated or treated to match standard factory coated ends. Copper tubing shall not be installed in the same trench with ferrous piping materials. When nonferrous metallic pipe (e.g., copper tubing) crosses any ferrous piping material, a minimum vertical separation of 12 inches shall be maintained between pipes. Connections between different types of pipe and accessories shall be made with transition fittings approved by the manufacturer of the piping system.

#### 3.5.1 Pitching of Horizontal Piping

Horizontal piping shall be pitched at a grade of not less than 1 inch in 20 feet toward the drain points unless otherwise indicated.

#### 3.5.2 Open Ends

Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt and other foreign matter out of the system.

#### 3.5.3 Cutting Prefabricated Piping Sections

Where prefabricated pipe sections are field cut, new end seals similar to the factory applied end seal shall be provided and installed in accordance with the manufacturer's instructions.

### 3.5.4 Joints

#### 3.5.4.1 Welded Joints

Welded joints between sections of pipe and between pipe and fittings shall be provided where specified or indicated.

#### 3.5.4.2 Threaded Joints

Threaded joints shall not be used belowground. Joints shall be made tight with polytetrafluoroethylene tape applied to the male threads only. Not more than 3 threads shall show after the joint is made up.

#### 3.5.4.3 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be the products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

#### 3.5.4.4 Brazed Joints

Brazed joints for copper pipe and fittings shall conform to CDA A4015. Brazing alloys melting above 1100 degrees F shall be utilized.

#### 3.5.4.5 Nonmetallic Pipe Joints

Nonmetallic pipe joints shall be installed in accordance with the written instructions of the manufacturer.

### 3.5.5 Expansion Loops

If expansion compensation is needed, expansion loops and expansion bends (Z- and L- type) shall be factory fabricated of casing, insulation, and carrier piping identical to that furnished for straight runs. Expansion loops and bends shall be properly designed in accordance with the allowable stress limits indicated in ASME B31.1 for the type of pipe used. Expansion loops and bends shall be shipped to the jobsite in the maximum size sections feasible to minimize the number of field joints. The expansion loops and bends casing and insulation where applicable, shall be suitably sized to accommodate pipe movement. Field joints shall be made in straight runs of the expansion loops and bends, and the number shall be kept to a minimum. For steel pipe, cold springing shall not be allowed when sizing the expansion loops and bends, but piping shall be cold sprung one-half the calculated maximum operational expansion during field assembly. Pipe stress in expansion loops and bends shall conform to the requirements for expansion loops specified in ASME B31.1.

### 3.5.6 Anchors

Anchor design shall be in accordance with the published data of the manufacturer and for prefabricated systems shall be factory fabricated by the prefabricated system manufacturer. In all cases, the design shall be such that water penetration, condensation, or vapor transmission will not wet the insulation.

### 3.5.7 Field Casing Closures

Field insulation and encasement of joints shall be accomplished after the visual and pressure tests specified are completed. Field insulation and encasement shall be in accordance with the manufacturer's written instructions. Thickness dimensions of the insulation and casing materials shall not be less than those of the adjoining prefabricated section. Insulating material shall be foamed in place polyurethane. Care should be taken to ensure that field closures are made under conditions of temperature and cleanliness required to produce a sound, continuous vapor barrier. A standard polyethylene heat shrink sleeve shall be installed over the casing and shall have a 6 inch minimum overlap at each end.

### 3.5.8 Underground Warning Tape

Underground warning tape shall be buried above the piping during the trench backfilling and shall be buried approximately 12 inches deep. Tape shall be 0.004 inch thick polyethylene tape or polyethylene tape with metallic core. Tape shall be 6 inches wide and be printed with repetitive caution warnings along its length. Tapes shall be yellow in color with black letters. Tape color and lettering shall not be affected by moisture or other substances contained in the backfill material.

### 3.5.9 Markers for Underground Piping

Markers for underground piping shall be placed as indicated approximately 2 feet to the right of the distribution system and referenced to the flow direction in the supply line. The marker shall be concrete 6 inch square or round section 2 feet long. The top edge of the marker shall have a minimum 1/2 inch chamfer all around. The letters CHW shall be impressed or cast on the top of the markers to indicate the type of system that is being identified. Each letter shall be formed with a V-shaped groove and shall have a width of stroke at least 1/4 inch at the top and depth of 1/4 inch. The top of the marker shall not protrude above finished grade.

## 3.6 EARTHWORK

Earthwork shall be performed in accordance with Section 02316A EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

## 3.7 ELECTRICAL WORK

Electrical work shall be performed in accordance with either Section 16375A ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND or Section 16370A ELECTRICAL DISTRIBUTION SYSTEM, AERIAL.

### 3.8 TESTING

Tests shall be conducted before, during, and after installation of the system. All instruments, equipment, facilities, and labor required to properly conduct the tests shall be provided by the Contractor. Test pressure gauges for a specific test shall have dials indicating not less than 1-1/2 times nor more than 2 times the test pressure. It shall be the Contractor's responsibility to make the pipe system workable at his expense.

#### 3.8.1 Metallic Pipe Welds

An approved independent testing firm or firms regularly engaged in radiographic testing shall perform a radiographic examination of the field welds. The radiographic testing shall be performed in accordance with ASME B31.1. All radiographs shall be reviewed and interpreted by a Certified Level III Radiographer employed by the testing firm. Any welds found to be unacceptable shall be removed, rewelded and radiographically reexamined in accordance with the above criteria. Such repair and reexamination shall be accomplished at no cost to the Government.

#### 3.8.2 Carrier Pipe Cleaning and Testing

Distribution piping shall be tested as required before backfilling and with all joints exposed. The area between joints may be backfilled as necessary to prevent pipe movement.

##### 3.8.2.1 Cleaning Carrier Pipe

Prior to testing, the interior of the carrier pipe shall be cleaned of foreign materials by thorough flushing with clean water. Water shall be circulated at a velocity between 2 and 3 m/s (7 and 10 feet per second) for a minimum of 4 hours. If required, temporary and/or supplementary pumps shall be provided to ensure that required velocity is achieved. System strainers shall be cleaned after the flushing operation is complete. Temporary strainers shall be installed as required. After flushing, the water shall remain in the piping system for testing of the system. All air shall be removed from the system prior to starting the tests.

##### 3.8.2.2 Hydrostatic Pressure Cycling and Tests

Hydrostatic pressure cycling shall have 4 cycles. Each cycle shall consist of a 10 minute period at 150 psig followed by a 5 minute period at a pressure less than 50 psig. The next cycle shall begin immediately following the completion of the previous cycle. Pressure rise and drop shall not exceed 100 psi per minute. The pressure gauge shall be located and the pressure measured at the opposite end of the system from where the pressure is applied. After completion of the hydrostatic pressure cycling, the first hydrostatic pressure test shall be performed. During the first hydrostatic pressure test, the system shall be proven tight at a pressure of 1-1/2 times the working pressure up to 150 psig. This pressure shall be held for a minimum of 1 hour. The method of pressurizing the system shall be disconnected from the system before starting the 1 hour pressure holding period. If the pressure cannot be held for the specified length of

time, the cause of pressure loss shall be determined, corrected and the hydrostatic pressure cycling and first hydrostatic pressure test shall be repeated until the system can hold the required pressure for at least 1 hour. After successful completion of the first hydrostatic pressure test, the water shall be drained out of the piping system and the piping system filled with treated water as defined in paragraph TREATED WATER for the remaining tests and for permanent operation of the system. The hydrostatic pressure cycling and tests shall be repeated after the system has been filled with treated water, using the same test conditions and criteria.

#### 3.8.2.3 Operational Test

Operational test shall be performed on the complete system or testable portions thereof. The test shall be conducted with full design flows and operating temperatures in all runs of piping as if in service, to demonstrate satisfactory function and operating effectiveness. The operational test will have two cycles. Each cycle shall consist of a 6-hour period with treated water in the system at the maximum operating temperature of 55 degrees F and maximum flow rate, and a period of at least 6-hours with no flow. The Contractor shall supply temporary pumps, piping connections, boilers, chillers and the gauges required to circulate the water at the desired temperatures and flow rates. Water shall be circulated through supply lines and returned through the return piping to demonstrate that the pressure drop is compatible with the flow rate and size of pipe and to show that obstructions do not exist in the piping system. Any unusual indicated pressure drop will be investigated and any obstructions removed. Any leaks found shall be repaired. After any obstructions have been removed and any leaks repaired, the operational test shall be repeated until successfully passed.

#### 3.8.2.4 Final Hydrostatic Test

After successful completion of the operational test, the system shall be pressurized to 1-1/2 times the working pressure up to 150 psig. This pressure shall be held for a minimum of 4 hours. Means of pressurizing shall be disconnected prior to the start of the 4-hour pressure holding period. If the pressure cannot be held for the specified length of time, the cause of the pressure loss shall be determined, corrected, and all of the hydrostatic pressure cycling and tests repeated.

-- End of Section --



## SECTION 02722A

AGGREGATE AND/OR GRADED--CRUSHED AGGREGATE BASE COURSE  
05/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO T 180 (2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

AASHTO T 224 (2001) Correction for Coarse Particles in the Soil Compaction Test

## ASTM INTERNATIONAL (ASTM)

ASTM C 117 (2003) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C 127 (2001) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C 128 (2001e1) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

ASTM C 131 (2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C 136 (2001) Sieve Analysis of Fine and Coarse Aggregates

ASTM C 29/C 29M (1997; R 2003) Bulk Density ("Unit Weight") and Voids in Aggregate

ASTM C 88 (1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM D 1556 (2000) Density and Unit Weight of Soil in

## Place by the Sand-Cone Method

ASTM D 1557	(2002) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 75	(2003) Sampling Aggregates
ASTM E 11	(2001) Wire Cloth and Sieves for Testing Purposes

## 1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

## 1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

## 1.2.2 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools;

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-06 Test Reports

Sieve Analysis: G  
Liquid Limit and Plasticity Index: G  
Moisture Determination: G

#### 1.4 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451A CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

##### 1.4.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

##### 1.4.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

###### 1.4.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11. Particle-size analysis of the soils shall also be completed in conformance with ASTM D 422.

###### 1.4.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

###### 1.4.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with ASTM D 1557.

##### 1.4.3 Approval of Material

The source of the material shall be selected 10 days prior to the time the material will be required in the work. Tentative approval of material will

be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted ABC.

#### 1.5 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

#### 1.6 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

### PART 2 PRODUCTS

#### 2.1 AGGREGATES

The ABC shall consist of clean, sound, durable particles of crushed stone, crushed gravel, angular sand, or other approved material. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

##### 2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

##### 2.1.1.1 Aggregate Base Course

Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

##### 2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

## 2.1.2.1 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

## 2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 1 1/2 inches and shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
-----			
2 inch	100	----	----
1-1/2 inch	70-100	100	----
1 inch	45-80	60-100	100
1/2 inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-8	0-8	0-8

NOTE 1: Particles having diameters less than 0.0008 inch shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

## 2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

## PART 3 EXECUTION

## 3.1 GENERAL REQUIREMENTS

When the ABC is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

## 3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from offsite sources.

## 3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

## 3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the ABC, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the ABC, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the ABC.

Stabilization shall be accomplished by mixing ABC into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the ABC is placed.

## 3.5 INSTALLATION

## 3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in

a traveling plant or bucket loader on an approved paved working area. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory ABC meeting all requirements of this specification.

#### 3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the ABC is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable ABC.

#### 3.5.3 Grade Control

The finished and completed ABC shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required ABC thickness so that the finished ABC with the subsequent surface course will meet the designated grades.

#### 3.5.4 Edges of Base Course

The ABC shall be placed so that the completed section will be a minimum of 5 feet wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of ABC in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of ABC. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

#### 3.5.5 Compaction

Each layer of the ABC shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly

different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory ABC. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

#### 3.5.6 Thickness

Compacted thickness of the aggregate course shall be as indicated in inches.

No individual layer shall exceed 6 inches nor be less than 3 inches in compacted thickness. The total compacted thickness of the ABC course shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the ABC course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

#### 3.5.7 Finishing

The surface of the top layer of ABC shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of ABC is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

#### 3.5.8 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 10 foot straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material



and compacting it to meet these specifications.

### 3.6 TRAFFIC

Traffic shall not be allowed on the completed ABC course.

### 3.7 MAINTENANCE

The ABC shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any ABC that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of ABC that is damaged shall be reworked or replaced as necessary to comply with this specification.

### 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as directed . No additional payments will be made for materials that must be replaced.

-- End of Section --

## SECTION 02742A

BITUMINOUS BINDER AND WEARING COURSES (CENTRAL-PLANT COLD-MIX)  
**07/97**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 20	(1970; R 2000) Penetration-Graded Asphalt Cement
AASHTO M 226	(1980; R 2000) Viscosity Graded Asphalt Cement
AASHTO M 81	(1992; R 2000) Cut-Back Asphalt (Rapid-Curing Type)
AASHTO T 40	(2002) Sampling Bituminous Materials

## ASTM INTERNATIONAL (ASTM)

ASTM C 117	(2003) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(2001) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	(2001e1) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 183	(2002) Sampling and the Amount of Testing of Hydraulic Cement
ASTM C 206	(2003) Finishing Hydrated Lime

ASTM C 29/C 29M	(1997; R 2003) Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 1250	(1980; R 2002) Petroleum Measurement Tables
ASTM D 140	(2001) Sampling Bituminous Materials
ASTM D 2028	(1997) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2172	(2001e1) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 242	(1995; R 2000e1) Mineral Filler for Bituminous Paving Mixtures
ASTM D 3381	(1992; R 1999) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 490	(1992; R 2001) Road Tar
ASTM D 633	(1997; R 2001) Volume Correction Table for Road Tar
ASTM D 75	(2003) Sampling Aggregates
ASTM D 946	(1982; R 1999) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 977	(2003) Emulsified Asphalt

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-03 Product Data

The job mix formula, at least 10 days before it is to be used.  
Notification on the selection of aggregate source. Notification  
on the selection of bituminous materials source.

### SD-06 Test Reports

Certified copies of aggregate test results, not less than 30 days before the material is required in the work.

#### SD-07 Certificates

##### Bituminous Material.

Certified copies of the bituminous material manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

### 1.3 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

#### 1.3.1 Mineral Aggregates

Mineral aggregates shall be delivered to the site and stockpiled in such a manner to preclude fracturing of aggregate particles, segregation, contamination or intermingling of different materials in the stockpiles or cold feed hoppers. Before stockpiling material, the storage areas should be cleared, drained and leveled. Mineral filler shall be delivered and stored in a manner to preclude exposure to moisture or other detrimental conditions.

#### 1.3.2 Bituminous Materials

Bituminous materials shall be maintained at appropriate temperature during storage but shall not be heated by application of direct flame to walls of storage tanks or transfer lines. Storage tanks, transfer lines, and weigh bucket shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 300 degrees F.

### 1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

#### 1.4.1 General Requirements

All plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall be adequate for placing the bituminous mixtures at a rate equal to the plant output. The equipment shall be capable of producing the required compaction, meeting grade controls, thickness control and smoothness requirements as set forth herein.

#### 1.4.2 Mixing Plant

The mixing plant shall be an automatic or semi-automatic controlled, commercially manufactured unit designed and operated to consistently produce a mixture within the job-mix formula (JMF).

#### 1.4.3 Rollers

Rollers shall be self-propelled, weigh not less than 10 tons and have a

maximum contact pressure of 90 psi. Wheels on the roller shall be equipped with adjustable scrapers and water sprinkling apparatus to keep the wheels wet to prevent the adherence of bituminous material. A sufficient number of rollers shall be used on the work so that one roller will be in continuous operation for 1 hour on each 100 square yards of completed pavement, operating at a speed of not more than 3 mph.

#### 1.4.4 Power Brooms and Power Blowers

Brooms and blowers shall be suitable for cleaning surfaces of the bases and the bituminous course.

#### 1.4.5 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 10 foot straightedge for each bituminous paver for use in testing the finished surface. Straightedges shall be constructed of aluminum or other approved lightweight metal and shall have blades of box girder cross section with flat bottom, reinforced to insure rigidity and accuracy. Straightedges shall be equipped with handles for operation on pavement.

#### 1.5 WEATHER LIMITATIONS

Bituminous courses shall be constructed only when the base course or existing pavement is dry and when the weather is not foggy or rainy. Unless otherwise directed, such courses shall not be constructed when the atmospheric temperature is below 60 degrees F.

#### 1.6 SAFETY PRECAUTIONS

No smoking or open flames will be permitted within 25 feet of heating, distributing or transferring operations of bituminous materials other than bituminous emulsions.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Bituminous Material

The bituminous material shall conform to AASHTO M 20 Penetration grade 85-100.

##### 2.1.2 Aggregates

Aggregates shall consist of crushed stone, crushed slag, crushed gravel, screenings, sand, and mineral filler. The portion of these materials retained on the No. 8 sieve shall be known as coarse aggregate; the portion passing the No. 8 sieve and retained on the No. 200 sieve, as fine aggregate; and the portion passing the No. 200 sieve, as mineral filler. The aggregate when blended shall conform to the gradation shown in TABLE I when tested in accordance with ASTM C 117 and ASTM C 136.

## 2.1.2.1 Coarse Aggregates

Coarse aggregates shall consist of clean, sound, durable particles meeting the following requirements:

- a. Percentage of loss shall not exceed 40 after 500 revolutions as determined in accordance with ASTM C 131.
- d. Crushed aggregate retained on the No. 4 sieve and each coarser sieve shall contain at least 75 percent by weight of crushed pieces having one or more fractured faces with an area of each face equal to at least 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes or fractures shall be at least 30 degrees to count as two fractured faces.
- e. Particle shape of crushed aggregates shall be essentially cubical. The quantity of flat and elongated particles in any sieve size shall not exceed 20 percent by weight when determined in accordance with ASTM D 4791.

## 2.1.2.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, durable particles of natural sand, crushed stone, slag or gravel that meets the requirements for abrasion resistance and soundness specified for coarse aggregate. Fine aggregate produced by crushing gravel shall have at least 90 percent by weight of crushed particles having two or more fractured faces in the portion retained on the No. 30 sieve.

## 2.1.2.3 Mineral Filler

Mineral filler shall conform to ASTM D 242.

## 2.1.3 Liquefiers

The use of liquefiers as anti-stripping agent is subject to prior approval by the Contracting Officer.

## 2.2 JOB MIX FORMULA (JMF)

No bituminous mixture shall be produced until a JMF has been determined by the Contractor and approved by the Contracting Officer. The formula will indicate the definite percentage of each sieve fraction of aggregate, the percentage of bituminous material and the temperature of the completed mixture as discharged from the mixer. The JMF will be allowed the tolerances given in TABLE II. Aggregate gradation and bitumen content may be adjusted, as directed, within the limits specified to improve paving mixtures.

## 2.3 SAMPLING AND TESTING

### 2.3.1 Initial Sampling and Testing

#### 2.3.1.1 Source of Aggregates

Sources from which aggregates are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days of the award of the contract. Tests for the evaluation of aggregates shall be made by an approved commercial laboratory at no expense to the Government. Tests for determining the suitability of aggregate shall include, but not limited to: gradation in accordance with ASTM C 136, abrasion resistance in accordance with ASTM C 131, and soundness in accordance with ASTM C 88.

#### 2.3.1.2 Source of Bituminous Materials

Sources from which bituminous materials are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days after the award of the contract.

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

#### 3.1.1 Base Course

The surface of the base course shall be cleaned of loose and foreign material. Ruts or soft yielding spots, areas having inadequate compaction, and deviations of surface from requirements specified for the base course shall be corrected by loosening affected areas, removing unsatisfactory material, adding approved material where required, reshaping, and recompact to line and grade to specified density requirements. The surface shall be sprayed with bituminous material.

#### 3.1.2 Existing Pavement

The existing pavement shall be cleaned of loose and foreign matter. Cracks 1/4 inch in width and larger shall be cleaned and filled with crack filler material. Deteriorated areas of the pavement shall be repaired as directed. The surface shall be sprayed with a thin coat of bituminous material.

### 3.2 GRADE CONTROL

The finished and completed surface course shall conform to the lines, grades, cross sections, and dimensions as indicated. Line and grade stakes shall be placed by the Contractor at the site of the work, to maintain indicated lines and grades.

### 3.3 MIXING

#### 3.3.1 Preparation of Mineral Aggregates

Each component of various sizes of aggregates blended in preparing

bituminous mixtures shall be placed in separate stockpiles in such manner that separate sizes will not be intermixed. Aggregate shall be fed into the cold elevator by means of separate mechanical feeders to produce a total aggregate graded within requirements specified.

### 3.4 TRANSPORTATION OF BITUMINOUS MIXTURES

Mixtures shall be transported to the site in trucks having tight, clean, smooth bodies. Deliveries shall be scheduled so that the spreading and rolling of all mixtures delivered to the site can be completed during daylight unless approved artificial light is provided.

### 3.5 PLACEMENT

#### 3.5.1 Thickness of Layer

The mixture shall be spread in a layer not greater than 2 inches in thickness. Each layer shall be allowed to cure at least 12 hours or longer if required to achieve proper curing before placing a succeeding layer.

#### 3.5.2 General Requirements for Use of Motor Grader

When approved motor graders are used for spreading the mixture, the material shall be placed on the roadbed in a windrow so that the proper amount of material is available to cover a predetermined width to the indicated compacted thickness. The motor grader may be used to aerate the mixture by working it back and forth across the roadbed in order to get the mixture to the proper condition for compaction.

#### 3.5.3 General Requirements for Use of Mechanical Spreader

When mechanical spreaders are used, the bituminous mixture shall be dumped into an approved mechanical spreader and placed as nearly continuous as possible. The speed of placing shall be adjusted to permit proper rolling.

#### 3.5.4 Offsetting Joints Between Succeeding Courses

Placing of a succeeding course shall be done in such a manner that the longitudinal joints of the succeeding course will not coincide with joints of the previous course and will be offset from joints in the previous course by at least 1 foot. Transverse joints in the succeeding course shall be offset by at least 2 feet from transverse joints in the previous course.

#### 3.5.5 Special Requirements for Laying Strips Succeeding Initial Strip

In laying each succeeding strip after the initial strip has been spread and compacted as specified, the blade of the motor grader or the screed of the mechanical spreader shall overlap previously placed strip 3 to 4 inches at a height required for compaction to produce a smooth, dense joint.

#### 3.5.6 Shoveling, Raking, and Tamping After Machine Spreading

Shovelers and rakers shall follow the spreading machine, raking, removing,



and adding mixture as required to obtain a course that, when completed, will conform to all specified requirements. Excessive handwork and broadcasting or fanning of mixture will not be permitted.

### 3.5.7 Hand Spreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. Mixture shall be spread uniformly in a loose layer of thickness that, when rolled, will conform to required thickness.

### 3.6 COMPACTION

Compaction shall begin immediately after placement. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. The speed of the roller shall be such that displacement of the material does not occur. The density of the compacted mixture shall be at least 96 percent of that of laboratory specimens of the same mixture subjected to 50 blows of the standard Marshall hammer.

### 3.7 EDGES OF PAVEMENT

The edges of the pavement shall be compacted to the required density and shall be straight and true to required lines. Approved material shall be placed along the edges of the pavement in such quantity as will compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple-layer course, allowing at least a 1 footwidth of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer of the pavement as directed.

### 3.8 FINISHING

The surface of the top layer shall be finished to grade and cross section shown. Finished surface shall be uniform texture. Light blading during rolling may be necessary for the finished surface to conform to the lines, grades, and cross sections. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic-marked prior to completion, such unsatisfactory portion shall be scarified, reworked, relaid, or replaced as directed. Should any portion of the course, when laid, become watersoaked for any reason, that portion shall be removed immediately, and the mix placed in a windrow, aerated, and then spread, shaped, and rolled as specified.

### 3.9 THICKNESS REQUIREMENTS

The compacted thickness of the pavement shall be within 1/2 inch of the thickness indicated. Where measured thickness of the pavement is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness of the pavement is more than 1/2 inch thicker than indicated, the pavement shall be considered as conforming to the specified thickness requirements.

### 3.10 SURFACE-SMOOTHNESS REQUIREMENTS

#### 3.10.1 Intermediate Courses

The surface of each intermediate course shall be checked longitudinally with a 10 foot straightedge and checked transversely with a template conforming to the specified cross section. The surface of the layer, after rolling shall not deviate more than 1/4 inch from the 10 foot straightedge nor 1/4 inch from the template. Any irregularities shall be corrected by loosening and reshaping the aggregate, removing or adding aggregate as required, and rerolling such areas.

#### 3.10.2 Finished Surfaces

##### 3.10.2.1 Other Than Roads and Streets

The surface of the finished pavement shall be checked longitudinally and transversely with a 10 foot straightedge. The finished surface of the finished pavement shall not deviate more than 1/4 inch from the 10 foot straightedge. Surface irregularities exceeding tolerances specified shall be corrected as directed.

### 3.11 JOINTS

Joints shall present the same texture, density, and smoothness as other sections of the course. Joints between old and new pavements or between successive days' work shall be made carefully to insure continuous bond between old and new sections of the course. Contact surfaces of previously constructed pavements shall be painted with a thin, uniform coat of bituminous material, just before the fresh mixture is placed.

#### 3.11.1 Transverse Joints

The roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued. The edge of the previously laid course shall be cut back to expose an even, vertical surface for the full thickness of the course. The fresh mixture shall be raked against the joints, thoroughly tamped, and then rolled.

#### 3.11.2 Longitudinal Joints

When the edges of the longitudinal joints are irregular, honeycombed, or poorly compacted, all unsatisfactory sections of the joint shall be cut back to expose an even, vertical surface for the full thickness of the course. Where required, fresh mixture shall be raked against the joint, thoroughly tamped, and then rolled.

-- End of Section --

## SECTION 02821A

FENCING  
**02/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM A 702	(1989; R 2000) Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM C 94/C 94M	(2003a) Ready-Mixed Concrete
ASTM F 1083	(1997; R 2003) Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 626	(1996a; R 2003) Fence Fittings
ASTM F 668	(1999a) Poly(Vinyl Chloride) (PVC) and other Organic Polymer-Coated Steel Chain-Link Fence Fabric
ASTM F 883	(1997) Padlocks
ASTM F 900	(2003) Industrial and Commercial Swing Gates
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 26	(1996) Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 53	(1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-07 Certificates

Chain Link Fence; G, A/E

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

## 1.3 APPROVAL OF POLYVINYL CHLORIDE-COATED FENCE MATERIALS

Polyvinyl chloride-coated fence materials shall be thoroughly inspected for cracking, peeling, and conformance with the specifications by the Contracting Officer's Representative prior to installation. Any fence materials rejected by the Contracting Officer's Representative shall be replaced by the contractor with approved materials at no additional cost to the Government.

## PART 2 PRODUCTS

### 2.1 FENCE FABRIC

Fence fabric shall conform to the following:

#### 2.1.1 Chain Link Fence Fabric

Class 2b polyvinyl chloride-coated steel fabric with 0.3 ounces of zinc coating per square foot in accordance with ASTM F 668. Fabric shall be fabricated of 9 gauge wire woven in 1 inch mesh. Polyvinyl chloride coating for fabric and all other fence components shall be manufacturer's standard black in color. Fabric height shall be as shown on the plan. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

#### 2.1.2 Woven Wire

Woven wire shall conform to ASTM A 116 No. 9 farm.

### 2.2 GATES

Gate shall be the type and swing shown. Gate frames shall be polyvinyl chloride-coated steel pipe Group IA with external coating Type A, a nominal pipe size 1-1/2, conforming to ASTM F 1043. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or

intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position.

## 2.3 POSTS

### 2.3.1 Metal Posts for Chain Link Fence

Post shall be either Group IA steel pipe, Group IC, Group II, roll-formed steel sections, and shall be polyvinyl chloride coated conforming to the requirements of ASTM F 1043. Sizes shall be as shown on the drawings. Line posts and terminal corner, gate, and pull posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

## 2.4 BRACES AND RAILS

Braces and rails shall be Group IA, steel pipe, size NPS 1-1/4 or Group II, formed steel sections, size 1-21/32 inch and shall be polyvinyl chloride-coated conforming to the requirements of ASTM F 1043. Group II, formed steel sections, size 1-21/32 inch, conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished.

## 2.5 WIRE

### 2.5.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

## 2.6 ACCESSORIES

ASTM F 626. Ferrous accessories shall also be polyvinyl chloride-coated, minimum thickness of 0.006 inch, maximum thickness of 0.015 inch. Color coating of fittings shall match the color coating of the fabric. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment.

## 2.7 CONCRETE

ASTM C 94/C 94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

## 2.8 PADLOCKS

Padlocks shall conform to ASTM F 883, Type A. All padlocks shall be keyed into

master key system as specified in Section 08710 DOOR HARDWARE.

### PART 3 EXECUTION

#### 3.1 GENERAL

The fencing for the chiller

#### 3.2 INSTALLATION

Fence shall be installed to the lines and grades indicated. Line posts shall be spaced as indicated on the plans. Terminal and corner, gate posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

#### 3.3 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 1/2 inch clearance between the bottom of the fabric and finish grade.

#### 3.4 POST INSTALLATION

##### 3.4.1 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Except where solid rock is encountered, interior posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Perimeter posts shall be attached to the finished slab using 4 inch galvanized flanges and 1/2 inch anchor bolts with 8 inch embedment. For high security fences, fence post rigidity shall be tested by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground; post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed,

replaced, and retested at the Contractor's expense.

### 3.5 RAILS

#### 3.5.1 Top Rail

Top rail shall be supported at each post to form a continuous brace between posts. Top rail, if required for high security fence, shall be installed as indicated on the drawings.

#### 3.5.2 Bottom Rail

The bottom rail shall be bolted to double rail ends and double rail ends shall be securely fastened to the posts. Bolts shall be peened to prevent easy removal. Bottom rail shall be installed before chain link fabric.

### 3.6 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed. 2 diagonal truss rods shall be installed on the horizontal fence panels. Truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 6 feet high or less if a top rail is installed.

Braces and truss rods shall be provided in the vertical and horizontal fence panels as follows:

#### 3.6.1 Vertical Panels

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence being furnished. Horizontal (compression) braces and 2 diagonal truss (tension) rods shall be installed on the vertical panels. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal.

##### 3.6.1.1 Horizontal Panels

Diagonal truss rods shall be installed between perimeter posts and intermediate posts and between intermediate posts to provide support for the chain link fabric. Fittings to accommodate the rails and truss rods shall be fabricated to fit this configuration. Shop drawings of the fence installation shall be submitted before fabrication of the fittings.

### 3.7 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 1 foot of the installed fabric. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

### 3.8 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15 inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately 12 inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. Seams in the horizontal fabric and splicing at the junction of the vertical and horizontal fabric shall be woven together with wire of the same guage and composition as the chain link fabric. The bottom of the installed vertical fabric shall be 1/2 inch above the ground. For high security fence, after the fabric installation is complete, the fabric shall be exercised by applying a 50 pound push-pull force at the center of the fabric between posts; the use of a 30 pound pull at the center of the panel shall cause fabric deflection of not more than 2-1/2 inches when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be resecured and retested at the Contractor's expense.

### 3.9 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

-- End of Section --



SECTION 03100A

STRUCTURAL CONCRETE FORMWORK  
**02/04**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 347R (2001) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

ASTM INTERNATIONAL (ASTM)

ASTM C 578 (2003a) Rigid, Cellular Polystyrene  
Thermal Insulation

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1 (1995) Construction and Industrial Plywood  
(APA V995)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Formwork

Drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal.

SD-03 Product Data

Design

Design analysis and calculations for form design and methodology used in the design.

#### Form Materials

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

#### Form Releasing Agents

Manufacturer's recommendation on method and rate of application of form releasing agents.

#### SD-04 Samples

##### Fiber Voids; G, A/E

One sample unit of fiber voids prior to installation of the voids.

#### SD-07 Certificates

##### Fiber Voids

Certificates attesting that fiber voids conform to the specified requirements.

### 1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

### 1.4 STORAGE AND HANDLING

Fiber voids shall be stored above ground level in a dry location. Fiber voids shall be kept dry until installed and overlaid with concrete.

## PART 2 PRODUCTS

### 2.1 FORM MATERIALS

#### 2.1.1 Forms For Class A and Class B Finish

Forms for Class A and Class B finished surfaces shall be plywood panels conforming to PS1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type.

## 2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to PS1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

## 2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

## 2.1.4 Pan-Form Units

Pan-form units for one-way or two-way concrete joist and slab construction shall be factory-fabricated units of the approximate section indicated. Units shall consist of steel or molded fiberglass concrete form pans. Closure units shall be furnished as required.

## 2.1.5 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter.

## 2.1.6 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

## 2.1.7 Fiber Voids

Fiber voids shall be the product of a reputable manufacturer regularly engaged in the commercial production of fiber voids. The voids shall be constructed of double faced, corrugated fiberboard. The corrugated fiberboard shall be fabricated of wet strength paper liners, impregnated with paraffin, and laminated with moisture resistant adhesive, and shall have a board strength of 275 psi. Voids which are impregnated with paraffin after construction, in lieu of being constructed with paraffin impregnated fiberboard, are acceptable. Voids shall be designed to support not less than 1000 psf. To prevent separation during concrete placement fiber voids shall be assembled with steel or plastic banding at 4 feet on center maximum, or by adequate stapling or gluing as recommended by the manufacturer. Fiber voids placed under concrete slabs and that are 8 inches in depth may be heavy duty "waffle box" type, constructed of paraffin

impregnated corrugated fiberboard.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class A or Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

#### 3.1.2 Fiber Voids

Voids shall be placed on a smooth firm dry bed of suitable material, to avoid being displaced vertically, and shall be set tight, with no buckled cartons, in order that horizontal displacement cannot take place. Each section of void shall have its ends sealed by dipping in paraffin, with any additional cutting of voids at the jobsite to be field dipped in the same type of sealer, unless liners and flutes are completely impregnated with paraffin. Prior to placing reinforcement, the entire formed area for slabs shall be covered with a 4 x 8 feet minimum flat sheets of fiber void corrugated fiberboard. Joints shall be sealed with a moisture resistant tape having a minimum width of 3 inches. If voids are destroyed or damaged and are not capable of supporting the design load, they shall be replaced prior to placing of concrete.

#### 3.1.3 Fiber Void Retainers

Fiber void retainers shall be installed, continuously, on both sides of fiber voids placed under grade beams in order to retain the cavity after the fiber voids biodegrade.

### 3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

### 3.3 COATING

Forms for Class A and Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces

may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

### 3.4 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

#### TOLERANCES FOR FORMED SURFACES

1. Footings:		
a. Variation of dimensions in plan	Minus -----	1/2 inch
	Plus -----	2 inches
	when formed or plus 3 inches	
	when placed against unformed excavation	
b. Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than 2 inches	
c. Reduction in thickness of specified thickness	Minus -----	5 percent
2. Variation in steps:		
	Riser -----	1/8 inch
a. In a flight of stairs	Tread -----	1/4 inch
b. In consecutive steps	Riser -----	1/16 inch

TABLE 1

TOLERANCES FOR FORMED SURFACES

Tread ----- 1/8 inch

-- End of Section --

## SECTION 03150A

## EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

09/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO T 111 (1983; R 2000) Inorganic Matter or Ash in  
Bituminous Materials

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

ASTM INTERNATIONAL (ASTM)

ASTM A 1011/A 1011M (2003a) Steel, Sheet and Strip, Hot-Rolled,  
Carbon, Structural, High Strength  
Low-Alloy and High-Strength Low-Alloy With  
Improved Formability

ASTM A 109/A 109M (2003) Steel, Strip, Carbon (0.25 Maximum  
Percent), Cold-Rolled

ASTM A 167 (1999) Stainless and Heat-Resisting  
Chromium-Nickel Steel Plate, Sheet, and  
Strip

ASTM A 480/A 480M (2003b) General Requirements for  
Flat-Rolled Stainless and Heat-Resisting  
Steel Plate, Sheet, and Strip

ASTM B 152/B 152M (2000) Copper Sheet, Strip, Plate, and  
Rolled Bar

ASTM B 370 (1998) Copper Sheet and Strip for Building  
Construction

ASTM C 920 (2002) Elastomeric Joint Sealants

ASTM D 1751 (1999) Preformed Expansion Joint Filler  
for Concrete Paving and Structural  
Construction (Nonextruding and Resilient

## Bituminous Types)

ASTM D 1752	(1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2628	(1991; R 1998) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 4	(1986; R 1998) Bitumen Content
ASTM D 412	(1998a; R 2002e1) Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 471	(1998e1) Rubber Property - Effect of Liquids
ASTM D 5249	(1995; R 2000) Backer Material for Use with Cold-and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

## U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Specifications for Polyvinylchloride Waterstops

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Waterstops; G, A/E

Shop drawings and fabrication drawings provided by the manufacturer or prepared by the Contractor.

## SD-03 Product Data

Preformed Expansion Joint Filler  
Sealant  
Waterstops

Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation;



field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals; and waterstops. Manufacturer's recommended instructions for installing preformed fillers, field-molded sealants; preformed compression seals; and waterstops; and for splicing non-metallic waterstops.

#### SD-04 Samples

##### Non-metallic Materials

Specimens identified to indicate manufacturer, type of material, size, quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 12 inch long cut from each 200 ft of finished waterstop furnished, but not less than a total of 4 ft of each type, size, and lot furnished. One splice sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site. The splice samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each splice shall be not less than 12 inches long.

#### SD-07 Certificates

Preformed Expansion Joint Filler  
Sealant  
Waterstops

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

### 1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

## PART 2 PRODUCTS

### 2.1 CONTRACTION JOINT STRIPS

Contraction joint strips shall be 1/8 inch thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

### 2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8 inch thick and of a width applicable for the joint formed. Backer

material, when required, shall conform to ASTM D 5249.

### 2.3 SEALANT

Joint sealant shall conform to the following:

#### 2.3.1 Preformed Polychloroprene Elastomeric Type

ASTM D 2628.

### 2.4 WATERSTOPS

Intersection and change of direction waterstops shall be shop fabricated.

#### 2.4.1 Flexible Metal

Copper waterstops shall conform to ASTM B 152/B 152M and ASTM B 370, O60 soft anneal temper and 20 oz mass per sq ft sheet thickness. Stainless steel waterstops shall conform to ASTM A 167 and ASTM A 480/A 480M, UNS S30453 (Type 304L), and 20 gauge thick strip.

#### 2.4.2 Rigid Metal

Flat steel waterstops shall conform to ASTM A 109/A 109M, No. 2 (half hard) temper, No. 2 edge, No. 1 (matte or dull) finish or ASTM A 1011/A 1011M, Grade 40.

#### 2.4.3 Non-Metallic Materials`

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572. Thermoplastic elastomeric rubber waterstops shall conform to ASTM D 471.

## PART 3 EXECUTION

### 3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

#### 3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8 inch wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 1 inch.

##### 3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable.

After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC or HIPS strips shall be discarded and the insert left in place. True alignment of the strips shall be maintained during insertion.

#### 3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

#### 3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8 inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

#### 3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

#### 3.2 WATERSTOPS, INSTALLATION AND SPLICES

Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed

projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified trained personnel using approved equipment and procedures.

#### 3.2.1 Copper And Stainless Steel

Splices in copper waterstops shall be lap joints made by brazing. Splices in stainless steel waterstops shall be welded using a TIG or MIG process utilizing a weld rod to match the stainless. All welds shall not be annealed to maintain physical properties. Carbon flame shall not be used in the annealing process. Damaged waterstops shall be repaired by removing damaged portions and patching. Patches shall overlap a minimum of 1 inch onto undamaged portion of the waterstop.

#### 3.2.2 Non-Metallic

Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter guide, proper fixturing (profile dependant), and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. The splicing of straight lengths shall be done by squaring the ends to be joined. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) shall be maintained across the splice.

##### 3.2.2.1 Rubber Waterstop

Splices shall be vulcanized or shall be made using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R shall be as specified for PVC.

##### 3.2.2.2 Polyvinyl Chloride Waterstop

Splices shall be made by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. The correct temperature shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

##### 3.2.2.3 Quality Assurance

Edge welding will not be permitted. Centerbulbs shall be compressed or closed when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of centerbulb, ribs, and end bulbs greater than 1/16 inch. 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joint deeper than 1/16 inch or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 1/2 inch in 10 feet. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

### 3.3 CONSTRUCTION JOINTS

Construction joints are specified in Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

-- End of Section --

## SECTION 03200A

CONCRETE REINFORCEMENT  
**02/04**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 318/318R (2002) Building Code Requirements for  
Structural Concrete and Commentary

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.4 (1998) Structural Welding Code -  
Reinforcing Steel

## AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1 (1996) Structural Welding Code Steel

## ASTM INTERNATIONAL (ASTM)

ASTM A 184/A 184M (2001) Fabricated Deformed Steel Bar Mats  
for Concrete Reinforcement

ASTM A 185 (2002) Steel Welded Wire Reinforcement,  
Plain, for Concrete

ASTM A 496 (2002) Steel Wire, Deformed, for Concrete  
Reinforcement

ASTM A 497 (2002) Steel Welded Wire Reinforcement,  
Deformed, for Concrete

ASTM A 53 (1999b) Pipe, Steel, Black and Hot-Dipped,  
Zinc-Coated, Welded and Seamless

ASTM A 615/A 615M (2003a) Deformed and Plain Billet-Steel  
Bars for Concrete Reinforcement

ASTM A 675/A 675M (1990a; R 2000) Steel Bars, Carbon,  
Hot-Wrought, Special Quality, Mechanical  
Properties

ASTM A 706/A 706M	(2003) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(2000b) Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 1MSP	(2001) Manual of Standard Practice
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement; G, A/E

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-03 Product Data

Welding

A list of qualified welders names.

SD-07 Certificates

Reinforcing Steel

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 WELDING

Welders shall be qualified in accordance with AWS D1.1/AWS D1.1. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.1/AWS D1.1.

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms,

skids, or other supports.

## PART 2 PRODUCTS

### 2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 80. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

### 2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

### 2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A 767/A 767M or ASTM A 775/A 775M as appropriate.

### 2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A 884/A 884M.

### 2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

### 2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 1MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

## PART 3 EXECUTION

### 3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318/318R. Reinforcement shall be cold



bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

#### 3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318/318R at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

#### 3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318/318R and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

#### 3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

#### 3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned

and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

#### 3.4 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452A SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --

## SECTION 03300A

CAST-IN-PLACE STRUCTURAL CONCRETE  
11/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 117	(1990) Standard Tolerances for Concrete Construction and Materials & Commentary
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 213R	(1987) Guide for Structural Lightweight Aggregate Concrete
ACI 214.3R	(1988; R 1997) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	(1999) Specifications for Structural Concrete for Buildings
ACI 303R	(1991) Guide to Cast-In-Place Architectural Concrete Practice
ACI 305R	(1999) Hot Weather Concreting
ACI 318/318R	(2002) Building Code Requirements for Structural Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 182	(1991; R 2000) Burlap Cloth Made from Jute or Kenaf
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## ASTM INTERNATIONAL (ASTM)

ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1999) Latex Agents for Bonding Fresh to Hardened Concrete

ASTM C 1064/C 1064M	(2003I) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(2003) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(2002) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)
ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2003) Slump of Hydraulic Cement Concrete
ASTM C 150	(2002ael) Portland Cement
ASTM C 171	(2003) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 192/C 192M	(2002) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2003) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 309	(2003) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2003a) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2003) Concrete Aggregates
ASTM C 330	(2003) Lightweight Aggregates for Structural Concrete
ASTM C 39/C 39M	(2003) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2003) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(1999ael) Chemical Admixtures for Concrete
ASTM C 496	(1996) Splitting Tensile Strength of Cylindrical Concrete Specimens

ASTM C 552	(2000e1) Cellular Glass Thermal Insulation
ASTM C 595	(2003) Blended Hydraulic Cements
ASTM C 618	(2003) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 685	(2000) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 78	(2002) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 937	(1997) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 94/C 94M	(2003a) Ready-Mixed Concrete
ASTM C 940	(1998a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 989	(1999) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 75	(2003) Sampling Aggregates
ASTM E 1155M	(1996; R 2001) Determining Floor Flatness and Floor Levelness Numbers (Metric)
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

## NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(2003) NIST Handbook 44: Specifications, Tolerances, and other Technical Requirements for Weighing and Measuring Devices
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## NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(2000) Concrete Plant Standards
NRMCA QC 3	(2002) Quality Control Manual: Section 3,

Plant Certifications Checklist:  
Certification of Ready Mixed Concrete  
Production Facilities

NRMCA TMMB 100 (2001) Truck Mixer, Agitator and Front  
Discharge Concrete Carrier Standards

## U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 104 (1980) Method of Calculation of the  
Fineness Modulus of Aggregate

COE CRD-C 400 (1963) Requirements for Water for Use in  
Mixing or Curing Concrete

COE CRD-C 521 (1981) Standard Test Method for Frequency  
and Amplitude of Vibrators for Concrete

COE CRD-C 572 (1974) Specifications for  
Polyvinylchloride Waterstops

COE CRD-C 94 (1995) Specification for Surface Retarders

## 1.2 LUMP SUM CONTRACT

Under this type of contract concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

## Mixture Proportions; G, A/E

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

## SD-04 Samples

Surface Retarder; G, A/E

Sample of surface retarder material with manufacturer's instructions for application in conjunction with air-water cutting.

SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G, A/E

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

SD-07 Certificates

Qualifications; G, A/E

Written documentation for Contractor Quality Control personnel.

1.4 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I  
Concrete Laboratory Testing Technician, Grade I or II  
Concrete Construction Inspector, Level II  
Concrete Transportation Construction Inspector or  
Reinforced Concrete Special Inspector, Jointly certified by

American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International (SBCCI).

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

1.5 SPECIAL REQUIREMENTS

A pre-installation meeting with the Contracting Officer will be required at least 10 days prior to start of construction on the chiller and air handler slabs. The Contractor shall be responsible for calling the meeting; the Project Superintendent and active installation personnel shall be present.

1.6 GENERAL REQUIREMENTS

1.6.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made

prior to removal.

## 1.6.2 Strength Requirements and w/c Ratio

### 1.6.2.1 Strength Requirements

Specified compressive strength ( $f'_c$ ) shall be as follows:

#### COMPRESSIVE STRENGTH

#### STRUCTURE OR PORTION OF STRUCTURE

use 4000 psi at 28 days

G, A/E

Concrete slabs on-grade shall have a 28-day flexural strength of 650 psi. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39/C 39M. Flexural strength shall be determined in accordance with ASTM C 78.

- a. Evaluation of Concrete Compressive Strength. Compressive strength specimens (6 by 12 inch cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength  $f'_c$  and no individual test result falls below the specified strength  $f'_c$  by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.
- b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.
- c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R.



Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

#### 1.6.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

WATER-CEMENT RATIO, BY WEIGHT	STRUCTURE OR PORTION OF STRUCTURE
0.42	Chiller and Air Handler Slabs, Handicap Ramp

These w/c's may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where or GGBF slag is used, the weight of the GGBF slag shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan.

#### 1.6.3 Air Entrainment

All normal weight concrete shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is 3/4 inch or smaller it shall be between 4.5 and 7.5 percent. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231.

#### 1.6.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143/C 143M.

Structural Element	Slump Minimum
Foundation walls, substructure walls, footings, slabs	1 in.    3 in.

When use of a plasticizing admixture conforming to ASTM C 1017/C 1017M or when a Type F or G high range water reducing admixture conforming to ASTM C 494/C 494M is permitted to increase the slump of concrete, concrete shall have a slump of 2 to 4 inches before the admixture is added and a maximum slump of 8 inches at the point of delivery after the admixture is added.

#### 1.6.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 90 degrees F.

When the ambient temperature during placing is 40 degrees F or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 55 and 75 degrees F.

#### 1.6.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

#### 1.6.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

### 1.7 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

#### 1.7.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratios required in subparagraph Water-Cement Ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where GGBF slag is used, the weight of the GGBF slag shall be included in the equations in ACI 211.1 for the term P, which is used to denote the weight of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall

also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M. They shall be tested at 7 and 28 days in accordance with ASTM C 39/C 39M. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

#### 1.7.2 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength ( $f'_{cr}$ ) exceeding the specified compressive strength ( $f'_c$ ) by the amount indicated below. This required average compressive strength,  $f'_{cr}$ , will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below  $f'_{cr}$  during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day  $f'_{cr}$ , the mixture shall be adjusted, as approved, to bring the daily average back up to  $f'_{cr}$ . During production, the required  $f'_{cr}$  shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

##### 1.7.2.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths ( $f'_c$ ) within 1,000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength  $f'_{cr}$  used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$f'_{cr} = f'_c + 1.34S$  where units are in psi

$f'_{cr} = f'_c + 2.33S - 500$  where units are in psi

Where  $S$  = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
30 or more	1.00

#### 1.7.2.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength  $f'_{cr}$  shall be determined as follows:

- a. If the specified compressive strength  $f'_c$  is 3,000 to 5,000 psi,

$$f'_{cr} = f'_c + 1,200 \text{ psi}$$

#### 1.8 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

#### 1.9 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

##### 1.9.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

##### 1.9.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

## 1.9.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

## 1.9.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

## PART 2 PRODUCTS

## 2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, or portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

## 2.1.1 Portland Cement

ASTM C 150, Type I low alkali with a maximum 15 percent amount of tricalcium aluminate, or Type II.

## 2.1.2 High-Early-Strength Portland Cement

ASTM C 150, Type III with tricalcium aluminate limited to 5 percent. Type III cement shall be used only in isolated instances and only when approved in writing.

## 2.1.3 Pozzolan (Fly Ash)

ASTM C 618, Class C with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. Requirement for maximum alkalis from Table 1A of ASTM C 618 shall apply. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

## 2.1.4 Ground Granulated Blast-Furnace (GGBF) Slag

ASTM C 989, Grade 120.

## 2.2 AGGREGATES

Aggregates shall conform to the following.

## 2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

## 2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 4M, size designation 7..

## 2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

### 2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

### 2.3.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

### 2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

### 2.3.4 High-Range Water Reducer

ASTM C 494/C 494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

### 2.3.5 Surface Retarder

COE CRD-C 94.

### 2.3.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C 937.

### 2.3.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

## 2.4 CURING MATERIALS

### 2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

### 2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors

that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

#### 2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

#### 2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

#### 2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade B, and shall be a commercial formulation suitable for the proposed application.

#### 2.7 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The aggregate shall be well graded from particles retained on the No. 30 sieve to particles passing the No. 8 sieve. This surfacing material shall be used on the handicap ramp only.

#### 2.8 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

#### 2.9 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

#### 2.10 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

#### 2.11 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Contracting Officer.

#### 2.12 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 6 mils or other equivalent material having a vapor permeance rating not

exceeding 0.5 perms as determined in accordance with ASTM E 96.

## 2.13 JOINT MATERIALS

### 2.13.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751. Materials for waterstops shall be in accordance with Section 03150A EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

### 2.13.2 Contraction Joints in Slabs

Sawable type contraction joint inserts shall conform to COE CRD-C 540. Nonsawable joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of Section 3.4 "Resistance to Sawing". Plastic inserts shall be polyvinyl chloride conforming to the materials requirements of COE CRD-C 572.

## PART 3 EXECUTION

### 3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03100A STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200A CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

#### 3.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

#### 3.1.2 Preparation of Rock

Rock surfaces upon which concrete is to be placed shall be free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, rock surfaces shall be cleaned thoroughly by the use of air-water jets or sandblasting as specified below for Previously Placed Concrete. Rock surfaces shall be kept continuously moist for at least 24 hours immediately prior to placing concrete thereon. All horizontal and approximately



horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. Concrete shall be placed before the mortar stiffens.

### 3.1.3 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 02300 EARTHWORK. The concrete shall be placed without becoming contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

### 3.1.4 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 12 inches. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 12 inches. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 2 inches wide and compatible with the membrane. Vapor barrier shall be placed directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier.

In this case, the surface shall be choked with a light layer of sand, as approved, before placing the vapor barrier. A 2 inch layer of compacted, clean concrete sand (fine aggregate) shall be placed on top of the vapor barrier before placing concrete. Concrete placement shall be controlled so as to prevent damage to the vapor barrier, or any covering sand.

### 3.1.5 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 1 foot of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

## 3.2 CONCRETE PRODUCTION

### 3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete.

#### 3.2.1.1 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall

conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Water shall not be added at the placing site unless specifically approved; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end.

### 3.3 CONCRETE PRODUCTION, SMALL PROJECTS

Batch-type equipment shall be used for producing concrete. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete.

### 3.4 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers .

### 3.5 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

#### 3.5.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

#### 3.5.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

#### 3.5.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94/C 94M. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less

than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

#### 3.5.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

#### 3.5.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means, such as discharge baffle or hopper, for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 36 inches.

The belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend through the reinforcing bars.

#### 3.5.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

### 3.6 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

#### 3.6.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where

specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary.

### 3.6.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.025 inch, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

### 3.6.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494/C 494M, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

### 3.6.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 85 degrees F, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at

time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	90 F
40-60	85 F
Less than 40	80 F

3.6.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.7 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 2 inches clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 30 pound asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints.

3.7.1 Construction Joints

Construction joints in slabs on grade shall be keyed or doweled as shown.

### 3.7.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Contraction Joints shall be produced by sawing a continuous slot with a concrete saw. The method used to produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 1/8 and 3/16 inch wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent ravelling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

### 3.7.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Section 03150A EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

### 3.7.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified in Section 03150A EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

### 3.7.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03200A CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1/8 inch in 12 inches. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

## 3.8 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section 03100A STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A or B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major

Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A and B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

#### 3.8.1 Class A Finish and Class B Finish

Class A finish is required on new stairs and handicap ramps. Fins, ravelings, and loose material shall be removed, all surface defects over 1/2 inch in diameter or more than 1/2 inch deep, shall be repaired and, except as otherwise indicated or as specified in Section 03100A STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 1/2 inch in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep. The Contractor shall prepare a sample panel for approval (as specified in PART 1) before commencing repair, showing that the surface texture and color match will be attained. Metal tools shall not be used to finish repairs in Class A surfaces.

#### 3.8.2 Class C and Class D Finish

Class C finish is required on the chiller and air handler slabs. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03100A STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 1/2 inch deep or more than 2 inches in diameter shall be repaired. Defects more than 2 inches in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep.

### 3.9 REPAIRS

#### 3.9.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 4 inches shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the No. 16 mesh sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

#### 3.9.2 Repair of Major Defects

Major defects will be considered to be those more than 1/2 inch deep or,

for Class A finishes more than 1/2 inch in diameter and, for Class C finishes, more than 2 inches in diameter. Also included are any defects of any kind whose depth is over 4 inches or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

#### 3.9.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 2 inches on all sides. All such defective areas greater than 12 square inches shall be outlined by saw cuts at least 1 inch deep. Defective areas less than 12 square inches shall be outlined by a 1 inch deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

#### 3.9.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 6 inches deep and also have an average diameter at the surface more than 18 inches or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special



concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

### 3.9.3 Resinous and Latex Material Repair

In lieu of the portland cement bonding coats specified above, an epoxy resin or a latex bonding agent may be used.

## 3.10 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

### 3.10.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 50 degrees F. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

### 3.10.2 Rough Slab Finish

As a first finishing operation for unformed surfaces the surface shall receive a rough slab finish prepared as follows. The chiller and air handler slabs shall receive a rough slab finish. The concrete shall be uniformly placed across the slab area, consolidated as previously

specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used.

### 3.10.3 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. The chiller and air handler slabs shall be given a float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 1/4 inch and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

### 3.10.4 Non-Slip Finish

Non-slip floors shall be constructed in accordance with the following subparagraphs.

#### 3.10.4.1 Broomed

The chiller and air handler slabs shall be given a broomed finish. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a coarse fiber push-type broom across the surface. Brooming shall be transverse to traffic or at right angles to the slope of the slab. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

### 3.11 EXTERIOR SLAB AND RELATED ITEMS

#### 3.11.1 Sidewalks

Concrete shall be 4 inches minimum thickness. Contraction joints shall be provided at 5 feet spaces unless otherwise indicated. Contraction joints shall be cut 1 inch deep with a jointing tool after the surface has been finished. Transverse expansion joints 1/2 inch thick shall be provided at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Sidewalks shall be given a lightly broomed finish. A transverse slope of 1/4 inch per foot shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1/4 inch in 5 feet.

#### 3.11.2 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 3 inches deep with a jointing tool after the surface has been finished. Expansion joints (1/2

inch wide) shall be provided at 100 feet maximum spacing unless otherwise indicated. Exposed surfaces shall be finished using a stiff bristled brush.

### 3.12 CURING AND PROTECTION

#### 3.12.1 General

Concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
All other concrete	7 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded.

Concrete containing silica fume shall be initially cured by fog misting during finishing, followed immediately by continuous moist curing. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

#### 3.12.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

#### 3.12.3 Membrane Forming Curing Compounds

Membrane forming curing compounds shall be used only on surfaces in the following areas, chiller, air handler slabs, stairs and any handicap ramp.

Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment

except the cleaning of loose sand, mortar, and debris from the surface. All surfaces shall be thoroughly moistened with water. Curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 75 psi, at a uniform coverage of not more than 400 square feet per gallon for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. Surfaces on which clear compound is used shall be shaded from direct rays of the sun for the first 3 days. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

#### 3.12.4 Impervious Sheeting

The following concrete surfaces may be cured using impervious sheets: Chiller and air handler slabs. However, except for plastic coated burlap, impervious sheeting alone shall not be used for curing. Impervious-sheet curing shall only be used on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 18 inches wider than the concrete surface to be covered. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

#### 3.12.5 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete.

#### 3.12.6 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 32 degrees F the temperature of the concrete shall be maintained above 40 degrees F for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by suitable temperature measuring devices furnished by the Contractor, as required, and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

### 3.13 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding

mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be approximately 1/24 the width of the plate, but not less than 3/4 inch. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed.

### 3.13.1 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

#### 3.13.1.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

### 3.14 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per week thereafter for conformance with ASTM C 1077.

#### 3.14.1 Grading and Corrective Action

##### 3.14.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and

retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

#### 3.14.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control.

However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

#### 3.14.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

#### 3.14.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

#### 3.14.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and

source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during each day's plant operation.

#### 3.14.5 Concrete Mixture

- a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.
- b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

- c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 1/2 inch below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.
- d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.
- e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.
- f. Strength Specimens. At least one set of test specimens shall be



made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 500 cubic yards or portion thereof of that concrete mixture placed each day. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

#### 3.14.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

#### 3.14.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

#### 3.14.8 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency

and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

#### 3.14.9 Curing Inspection

- a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.
- b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.
- c. Membrane Curing Inspection. No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, shall compute the rate of coverage in square feet per gallon, and shall note whether or not coverage is uniform.
- d. Membrane Curing Corrective Action. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.
- e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.
- f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

#### 3.14.10 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

#### 3.14.11 Mixer Uniformity

- a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.
- b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the

performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

- c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

#### 3.14.12 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

-- End of Section --

## SECTION 04200

MASONRY  
09/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 318M/318RM	(2002) Metric Building Code Requirements for Structural Concrete and Commentary
ACI 530/530.1	(2002) Building Code Requirements for Masonry Structures and Specifications for Masonry Structures and Commentaries
ACI SP-66	(1994) ACI Detailing Manual

## ASTM INTERNATIONAL (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 615/A 615M	(2003a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM C 1019	(2003) Sampling and Testing Grout
ASTM C 1072	(2000a) Measurement of Masonry Flexural Bond Strength
ASTM C 1142	(1995; R 2001) Extended Life Mortar for Unit Masonry
ASTM C 129	(2003) Nonloadbearing Concrete Masonry Units

ASTM C 140	(2003) Sampling and Testing Concrete Masonry Units and Related Units
ASTM C 144	(2003) Aggregate for Masonry Mortar
ASTM C 150	(2002a <sup>1</sup> ) Portland Cement
ASTM C 207	(1991; R 1997) Hydrated Lime for Masonry Purposes
ASTM C 216	(2003a) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 27	(1998; R 2002) Fireclay and High-Alumina Refractory Brick
ASTM C 270	(2003) Mortar for Unit Masonry
ASTM C 476	(2002) Grout for Masonry
ASTM C 494/C 494M	(1999a <sup>1</sup> ) Chemical Admixtures for Concrete
ASTM C 62	(2001) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 652	(2001a) Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
ASTM C 67	(2003a) Sampling and Testing Brick and Structural Clay Tile
ASTM C 780	(2002) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 90	(2003) Loadbearing Concrete Masonry Units
ASTM C 91	(2003a) Masonry Cement
ASTM C 94/C 94M	(2003a) Ready-Mixed Concrete
ASTM D 2287	(1996; R 2001) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 119	(2000a) Fire Tests of Building Construction and Materials
ASTM E 514	(2002) Water Penetration and Leakage Through Masonry

## INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC

(2003)International Plumbing Code

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Structural Masonry; G, A/E

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings. Bar splice locations shall be shown. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66.

## SD-03 Product Data

Clay or Shale Brick; G, A/E

Flashing; G, A/E

Water-Repellant Admixture; G, A/E

Manufacturer's descriptive data.

Cold Weather Installation; G, A/E

Cold weather construction procedures.

## SD-04 Samples

Concrete Masonry Units (CMU); G, A/E

Clay or Shale Brick; G, A/E

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture. Submit sample of colored mortar with applicable masonry unit.

Anchors, Ties, and Bar Positioners; G, A/E

Two of each type used.

Expansion-Joint Materials; G, A/E

One piece of each type used.

Joint Reinforcement; G, A/E

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

Portable Panel; G, A/E

One panel of clay or shale brick, 2 by 2 feet, containing approximately 24 brick facings to establish range of color and texture.

#### SD-05 Design Data

Pre-mixed Mortar; G, A/E

Unit Strength Method; G, A/E

Pre-mixed mortar composition. Calculations and certifications of masonry unit and mortar strength.

#### SD-06 Test Reports

Efflorescence Test; G, A/E

Field Testing of Mortar; G, A/E

Field Testing of Grout; G, A/E

Prism tests; G, A/E

Masonry Cement; G, A/E

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection; G, A/E

Copies of masonry inspector reports.

#### SD-07 Certificates

Clay or Shale Brick

Concrete Masonry Units (CMU)

Control Joint Keys

Anchors, Ties, and Bar Positioners  
Expansion-Joint Materials  
Joint Reinforcement  
Reinforcing Steel Bars and Rods  
Masonry Cement  
Admixtures for Masonry Mortar  
Admixtures for Grout

Certificates of compliance stating that the materials meet the specified requirements.

#### SD-08 Manufacturer's Instructions

##### Masonry Cement

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

### 1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, a portable panel of clay or shale brick and sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

#### 1.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 8 feet long by 4 feet high.

#### 1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain a stacked bond corner that includes a bond beam corner. Panels shall show parging. Panels that represent reinforced masonry shall contain a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.



### 1.3.3 Construction Method

Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

### 1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

## 1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

### 1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather. Store Type II, concrete masonry units at the site for a minimum of 28 days for air cured units, 10 days for atmospheric steam or water cured units, and 3 days for units cured with steam at a pressure of 120 to 150 psi and at a temperature of 350 to 365 degrees F for at least 5 hours. Protect moisture controlled units (Type I) from rain and ground water. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

### 1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

### 1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

## 1.5 STRUCTURAL MASONRY

## 1.5.1 Special Inspection

A qualified masonry inspector approved by the Contracting Officer shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure Contractor compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction.

## 1.5.2 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method," ACI 530/530.1. Submit calculations and certifications of unit and mortar strength.

## 1.5.3 Seismic Requirement

In addition to design requirements of ICC IPC, the Contractor shall provide additional seismic reinforcement in accordance with TI 809-04. The total minimum reinforcing percentage for structural walls shall be 0.20 percent and non-structural walls shall be 0.15 percent. The maximum spacing of reinforcing bars shall be as follows:

<u>Wall Type</u>	<u>Vertical</u>	<u>Horizontal</u>
Structural	24 inches	48 inches
Non-structural	48 inches	80 inches

Bond beams are required at the top of footings.

## 1.6 QUALITY ASSURANCE

## 1.6.1 Appearance

Bricks shall be manufactured at one time and from the same batch. Blend all brick to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable.

## 1.6.2 Testing

Masonry strength shall be determined in accordance with ACI 530/530.1; submit test reports on three prisms as specified in ACI 530/530.1. The

cost of testing shall be paid by the Contractor.

#### 1.6.3 Bracing and Scaffolding

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

### PART 2 PRODUCTS

#### 2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

#### 2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Brick shall conform to ASTM C 62; Grade SW shall be used for brick in contact with earth or grade and for the first six exterior courses above grade and for all nonvertical surfaces. Grade SW or MW shall be used in other brickwork. Average dimensions of brick shall be 3-5/8 inches thick, 2-1/4 inches high, and 8 inches long (standard) or 4 inches thick, 2-2/3 inches high, and 8 inches long (nominal), subject to the tolerances specified in ASTM C 62. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

##### 2.2.1 Solid Clay or Shale Brick

Solid clay or shale brick shall conform to ASTM C 62. Brick size shall be modular and the size of the brick used shall be 3-5/8 inches thick, 2-1/4 inches high, and 7 5/8 inches long, or 4 inches thick, 2-2/3 inches high and 8 inches long (nominal). Minimum compressive strength of the brick shall be 2,500 psi.

#### 2.3 CONCRETE MASONRY UNITS (CMU)

Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions and air, water, or steam cured. Exposed surfaces of units shall be smooth and of uniform texture. Exterior concrete masonry units shall have water-repellant admixture added during manufacture.

- a. Hollow Load-Bearing Units: ASTM C 90, Type I or II, made with normal weights aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

##### 2.3.1 Kinds and Shapes

Units shall be modular in size and shall include lintel, units to complete the work as indicated.

## 2.4 PRECAST CONCRETE ITEMS

Trim, lintels, copings, splashblocks and door sills shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 4,000 psi minimum conforming to Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inch shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises and shall be cast with drip grooves on the underside where units overhang walls. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

### 2.4.1 Lintels

Precast lintels, unless otherwise shown, shall be of a thickness equal to the wall and reinforced with two No. 4 bars for the full length. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure. In reinforced masonry, lintels shall conform to ACI 318M/318RM for flexural and shear strength and shall have at least 8 inches bearing at each end. Concrete shall have a minimum 28 day compressive strength of 4,000 psi using 1/2 inch to No. 4 nominal-size coarse aggregate. Reinforcement shall conform to ASTM A 615/A 615M Grade 60. Limit lintel deflection due to dead plus live load to  $L/600$  or 0.3 inches. Provide top and bottom bars for lintels over 36 inches in length.

## 2.5 MORTAR FOR STRUCTURAL MASONRY

ASTM C 270, Type M S. Strength ( $f'm$ ) as indicated. Test in accordance with ASTM C 780. Use Type I or II portland cement. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar and 18 percent in masonry cement mortar.

### 2.6 MASONRY MORTAR

Type M mortar shall conform to ASTM C 270 and shall be used for foundation walls. Mortar Type S shall conform to the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate.

Type S mortar shall be used for non-load-bearing, non-shear-wall interior masonry; and remaining masonry work. When masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

#### 2.6.1 Admixtures for Masonry Mortar

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C.

#### 2.6.2 Colored Mortar

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color. Quantity of pigment to cementitious content of the masonry cement shall not exceed 3 percent by weight; carbon black shall not exceed 1 percent by weight. Quantity of pigment to cementitious content of cement-lime mix shall not exceed 10 percent by weight, carbon black no more than 2 percent by weight. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement. Compressive strength of colored mortar shall equal 1,350 psi.

#### 2.6.3 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C 207, Type S. Lime alternates which have a current ICBO, ICBO UBC, Evaluation Report number whose findings state it may be used as an alternate to lime for Type M, S, mortars will be deemed acceptable provided the user follows the manufacturer's proportions and mixing instructions as set forth in ICBO report.

#### 2.6.4 Cement

Portland cement shall conform to ASTM C 150, Type I, II, or III. Masonry cement shall conform to ASTM C 91, Type M. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

#### 2.6.5 Pre-Mixed Mortar

Pre-mixed mortar shall conform to ASTM C 1142, Type RS or RM.

#### 2.6.6 Sand and Water

Sand shall conform to ASTM C 144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

## 2.7 WATER-REPELLANT ADMIXTURE

Polymeric type formulated to reduce porosity and water transmission. Construct panels of masonry units conforming to ASTM C 744 and mortar which contain the water-repellant admixture. When tested in accordance with ASTM C 1072, such panels shall have flexural strength not less than that specified or indicated. When tested in accordance with ASTM E 514, panels shall exhibit no water visible on back of test panel and no leaks through the panel after 24 hours, and not more than 25 percent of wall area shall be damp after 72 hours.

## 2.8 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C 476, fine. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Minimum grout strength shall be 2000 psi in 28 days, as tested by ASTM C 1019. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C 94/C 94M.

### 2.8.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer.

### 2.8.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

## 2.9 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Wire ties or anchors in exterior walls shall conform to ASTM A 641/A 641M. Joint reinforcement in interior walls, and in exterior or interior walls exposed to moist environment shall conform to ASTM A 641/A 641M; coordinate with paragraph JOINT REINFORCEMENT below. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

### 2.9.1 Wire Mesh Ties

Wire mesh for tying 4 inch thick concrete masonry unit partitions to other intersecting masonry partitions shall be 1/2 inch mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 12 inches.

### 2.9.2 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 4 inches wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

### 2.9.3 Dovetail Anchors

Dovetail anchors shall be of the flexible wire type, 3/16 inch diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. These anchors shall be used for anchorage of veneer wythes or composite-wall facings extending over the face of concrete columns, beams, or walls. Cells within vertical planes of these anchors shall be filled solid with grout for full height of walls or partitions, or solid units may be used. Dovetail slots are specified in Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE.

### 2.9.4 Adjustable Anchors

Adjustable anchors shall be 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16 inch play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

### 2.9.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

### 2.10 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint

reinforcement may be furnished with adjustable wall tie features.

#### 2.11 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

#### 2.12 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000 or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

#### 2.13 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07920 JOINT SEALANTS.

#### 2.14 FLASHING

Flashing shall be as specified in Section 07600 FLASHING AND SHEET METAL. Provide one of the following types except that flashing indicated to terminate in reglets shall be metal or coated-metal flashing and except that the material shall be one which is not adversely affected by dampproofing material.

- a. Coated-Copper Flashing: 7 ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, elastic bituminous compound. Factory apply coating to a weight of not less than 6 ounces per square foot (approximately 3 ounces per square foot on each side).
- b. Copper or Stainless Steel Flashing: Copper, ASTM B 370, minimum 16 ounce weight; stainless steel, ASTM A 167, Type 301, 302, 304, or 316, 0.015 inch thick, No. 2D finish. Provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.
- c. Reinforced Membrane Flashing: Polyester film core with a reinforcing fiberglass scrim bonded to one side. The membrane shall be impervious to moisture, flexible, and not affected by



caustic alkalis. The material, after being exposed for not less than 1/2 hour to a temperature of 32 degrees F, shall show no cracking when, at that temperature, it is bent 180 degrees over a 1/16 inch diameter mandrel and then bent at the same point over the same size mandrel in the opposite direction 360 degrees.

## 2.15 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum, plastic or wood blocking sized to form the proper size opening in head joints. Provide aluminum and plastic inserts with grill or screen-type openings designed to allow the passage of moisture from cavities and to prevent the entrance or insects. Ventilators shall be sized to match modular construction with a standard 3/8 inch mortar joint.

## PART 3 EXECUTION

### 3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable Conditions as set forth in ACI 530/530.1, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

#### 3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 90 degrees F and the wind velocity is more than 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

#### 3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F or temperature of masonry units is below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

##### 3.1.2.1 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

- a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F.
- b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 and 120

degrees F. Temperature of mortar on boards shall be maintained above freezing.

- c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.
- d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

#### 3.1.2.2 Completed Masonry and Masonry Not Being Worked On

- a. Mean daily air temperature 40 to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.
- b. Mean daily air temperature 32 to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.
- c. Mean Daily Air Temperature 25 to 20 degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.
- d. Mean Daily Temperature 20 degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

#### 3.1.3 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

#### 3.1.4 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

#### 3.1.5 Surfaces

Surfaces on which masonry is to be placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

### 3.2 LAYING MASONRY UNITS

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

#### 3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

#### 3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

### 3.2.3 Concrete Masonry Units

Units in pilasters, columns, starting courses on footings, solid foundation walls, and lintels, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

### 3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view.

#### 3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid. Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

#### 3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

#### 3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

#### 3.2.4.4 Brick-Faced Walls

For brick-faced walls bond brick in the pattern as indicated on the drawings. Provide additional bonding ties spaced not more than 3 feet apart around the perimeter of and within 12 inches of all openings.

- a. Collar Joints: Fill collar joints solid with mortar as each course of brick is laid. Do not disturb units in place.

- b. Brick Sills: Lay brick on edge, slope, and project not less than 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.

#### 3.2.4.5 Brick Veneer

Provide a continuous cavity as indicated. Install brick veneer after sheathing, masonry anchors, and flashing have been installed to the cold-formed steel framing system. Damaged flashing shall be repaired or replaced before brick veneer is installed. Means shall be provided to keep cavities clean and clear of mortar droppings.

#### 3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

#### TOLERANCES

Variation from the plumb in the lines  
and surfaces of columns, walls and arises

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In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from the plumb for external corners,  
expansion joints, and other conspicuous lines

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In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels,  
sills, parapets, horizontal grooves, and other  
conspicuous lines

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In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from level for bed joints and top  
surfaces of bearing walls

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In 10 feet	1/4 inch
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## TOLERANCES

In 40 feet or more	1/2 inch
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Variations from horizontal lines

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In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

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Variations in cross sectional dimensions of  
columns and in thickness of walls

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Minus	1/4 inch
Plus	1/2 inch

## 3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

## 3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

## 3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

## 3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and

the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

#### 3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of  $\frac{3}{8}$  inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of  $\frac{3}{8}$  inch.

#### 3.2.8 Joint Widths

Joint widths shall be as follows:

##### 3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have  $\frac{3}{8}$  inch joints, except for prefaced concrete masonry units.

##### 3.2.8.2 Prefaced Concrete Masonry Units

Prefaced concrete masonry units shall have a joint width of  $\frac{3}{8}$  inch wide on unfaced side and not less than  $\frac{3}{16}$  inch nor more than  $\frac{1}{4}$  inch wide on prefaced side.

##### 3.2.8.3 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

#### 3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

#### 3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

#### 3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

### 3.3 WEEP HOLES

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior. Weep holes shall be clear round holes not less than 1/4 inch in diameter at 24 inches o.c. Weep holes shall be provided not more than 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be constructed using weep hole ventilators. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

### 3.4 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. Facing shall be anchored to concrete backing with wire dovetail anchors set in slots built in the face of the concrete as specified in Section 03300A CAST-IN-PLACE STRUCTURAL CONCRETE. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 16 inches on center vertically and 24 inches on center horizontally. Unit ties shall be spaced not over 24 inches on centers horizontally, in courses not over 16 inches apart vertically, staggered in alternate courses. Ties shall be laid not closer than 5/8 inch to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

### 3.5 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

### 3.6 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

#### 3.6.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical



reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

### 3.6.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

### 3.7 JOINT REINFORCEMENT INSTALLATION

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 5/8 inch cover to either face of the unit.

### 3.8 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

#### 3.8.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

#### 3.8.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

#### 3.8.3 Grout Holes and Cleanouts

##### 3.8.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 16 inches on centers shall be

provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

#### 3.8.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

#### 3.8.3.3 Cleanouts for Solid Unit Masonry Construction

Cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes shall be provided at the bottom of every pour by omitting every other masonry unit from one wythe. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanout holes shall not be plugged until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

#### 3.8.4 Grouting Equipment

##### 3.8.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

##### 3.8.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

### 3.8.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

#### 3.8.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

#### 3.8.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in

one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

## POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2)	
			Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3

## Notes:

- (1) The actual grout space or cell dimension must be larger than the sum of the following items:
  - a) The required minimum dimensions of total clear areas given in the table above;
  - b) The width of any mortar projections within the space;
  - c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.
- (2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.
- (3) For grouting spaces between masonry wythes.
- (4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

## 3.9 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum

clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

### 3.10 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using sash jamb units with control joint key in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07920 JOINT SEALANTS. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

### 3.11 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

Brick expansion joints and concrete masonry veneer joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

### 3.12 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 10 feet and installed with a 1/4 inch gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 4 feet, unless limited by wall configuration.

### 3.13 LINTELS

#### 3.13.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

#### 3.13.2 Precast Concrete and Steel Lintels

Precast concrete lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Precast lintels shall have a minimum bearing length of 8 inches unless otherwise indicated on the drawings.

### 3.14 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

#### 3.14.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 16 inches on centers vertically and 24 inches on center horizontally.

#### 3.14.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

### 3.15 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

#### 3.15.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

#### 3.15.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 1/2 cup trisodium phosphate and 1/2 cup laundry detergent to one gallon of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

### 3.16 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

### 3.17 TEST REPORTS

#### 3.17.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 1/2 to 5/8 inch thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

#### 3.17.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days.

#### 3.17.3 Efflorescence Test

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

#### 3.17.4 Prism Tests

At least one prism test sample shall be made for each 5,000 square feet of wall but not less than three such samples shall be made for any building. Three prisms shall be used in each sample. Prisms shall be tested in accordance with ACI 530/530.1. Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. Compressive strength shall not be less than 1,350 psi at 28 days. If the compressive strength of any prism falls below the specified value by more than 500 psi, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, three specimens shall be taken for each prism test more than 500 psi below the specified value. Masonry in the area in question shall be considered structurally adequate if the average compressive strength of three specimens is equal to at least

85 percent of the specified value, and if the compressive strength of no single specimen is less than 75 percent of the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results shall be permitted.

3.18 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452A SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --



## SECTION 04900

RESTORATION AND CLEANING OF MASONRY IN HISTORIC STRUCTURES  
**12/03**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ACI INTERNATIONAL (ACI)

ACI C-20 (1992) Repair and Rehabilitation II

## AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100Doc (2001) Documentation of the Threshold  
Limit Values and Biological Exposure  
Indices

## ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M (2001) Carbon Structural Steel

ASTM C 109/C 109M (2002) Compressive Strength of Hydraulic  
Cement Mortars (Using 2-in. 50-mm Cube  
Specimens)

ASTM C 150 (2002a) Portland Cement

ASTM C 207 (1991; R 1997) Hydrated Lime for Masonry  
Purposes

ASTM C 881/C 881M (2002) Epoxy-Resin-Base Bonding Systems  
for Concrete

ASTM C 1324 (2002a) Examination and Analysis of  
Hardened Masonry Mortar

ASTM STP935 (1986) Cleaning Stone and Masonry

## BRICK INDUSTRY ASSOCIATION (BIA)

BIA Tech Note 20 Rev II (1990) Cleaning Brick Masonry

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as

otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Masonry; G, AE

Drawings showing location of masonry elements in the work, building elevations, interface with adjacent materials, and special placing instructions, in sufficient detail to cover fabrication, placement, and finishing.

SD-03 Product Data

Cleaning and Restoration Methods; G, AE

Descriptive narrative in cleaning and repair methods to be employed in the work. Description shall be organized in sequence from preparation through completion of the work. Schedule showing estimated time, in calendar days, for completion of each phase of the work shall be included.

Qualifications

Documentation showing Contractor's experience of 5 consecutive years in masonry restoration, plus a list of similar jobs to the one specified herein.

SD-04 Samples

Materials

Sample Masonry Panels; G, AE

Samples of the materials listed below; indicating sizes, shapes, finishes, color, and pertinent accessories: . Masonry Panels, as specified.

SD-07 Certificates

Materials

Certificates of compliance attesting that the materials, equipment, and cleaning agents (chemicals, detergents, etc.) to be used in the work meet the specified requirements.

1.3 GENERAL REQUIREMENTS

Work shall be done in conformance with ACI C-20. Non-historic masonry work, including materials, procedures, and requirements shall conform to Section 04200 MASONRY, except as otherwise specified herein.

### 1.3.1 Cleaning and Restoration Methods

The cleaning and restoration methods, and materials selected for a specific structure, shall be submitted for approval before work starts, and shall take into account the total construction system of the building to be worked upon, including different masonry and mortar materials, as well as non-masonry elements which may be affected by the work.

### 1.3.2 Ionic Cleaners

Ionic chemical cleaners shall be used as specified, in accordance with the manufacturer's instructions, and only upon the direction of the Contracting Officer. Ionic cleaners shall be used only after gentler cleaning methods have been determined to be ineffective through the use of test panels.

## 1.4 QUALIFICATIONS

The Contractor shall provide qualified workers, trained and experienced in restoration of masonry in historic structures, and shall furnish documentation of 5 consecutive years of work of this type. A list of similar jobs shall be provided identifying when, where, and for whom the work was done.

## 1.5 EQUIPMENT AND TECHNIQUES DEMONSTRATION

Equipment and techniques of operation shall be demonstrated in an approved location and shall be subject to approval. Dependable and sufficient equipment, appropriate and adequate to accomplish the work specified, shall be assembled at the work site in sufficient lead time before the start of the work to permit inspection, calibration of weighing and measuring devices, adjustment of parts, and the making of any repairs that may be required. The equipment shall be maintained in good working condition throughout the project.

### 1.5.1 Cleaning Equipment

Cleaning equipment shall not cause staining, erosion, marring, or other damage or changes in the appearance of the surfaces to be cleaned.

#### 1.5.1.1 Sandblasting

Sandblasting equipment will not be allowed for cleaning masonry surfaces.

#### 1.5.1.2 Water Blasting

Water blasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, wand with safety release cutoff control, nozzle, and auxiliary water re-supply equipment. The equipment shall not be operated at a pressure which will cause etching or other damage to the masonry surface or mortar joints. The equipment shall be operated at a discharge capacity of 55 to 500 psi and 2.5 to 3 gpm for general surface cleaning operations. The water tank and auxiliary re-supply equipment shall be of sufficient capacity to permit continuous operations. The Contractor shall provide protective covers and barriers as required to prevent over-spray

onto adjacent surfaces.

#### 1.5.2 Drilling Equipment

Equipment used to drill holes in masonry, for patch anchors and other applications, shall be standard handheld masonry drills, commonly used for drilling small holes in concrete and masonry. The drill shall be a small, powered, handheld type, using rotary drilling mode only. Impact and rotary impact type drills will not be allowed.

#### 1.5.3 Finishing and Texturing Equipment

Equipment and hand tools used for placing, finishing and texturing masonry and mortar shall be commercially available and commonly used in masonry construction and repair. Surface grinders, impact tools, and other equipment shall conform to the specified requirements, except as specifically required by the type of finish and texture.

#### 1.5.4 Compressed Air Supplies

Compressed air equipment shall deliver clean, oil and moisture free compressed air at the surface to be cleaned. The compressed air line shall have at least two in-line air filters to remove oil and moisture from the air supply. The compressed air supply shall be tested during each shift for the presence of oil and moisture.

#### 1.5.5 Material Handling and Associated Equipment

##### 1.5.5.1 Mixing, Transporting, and Placing Job Materials

Equipment used for mixing, transporting, placing, and confining masonry and mortar placements shall be capable of satisfactorily mixing material and supporting placement operations in an uninterrupted manner. Defects and deficiencies in operation or capacity shall be resolved prior to use in the work. Equipment used for mixing, conveying, and placing of materials shall be clean, free of old materials and contaminants, and shall conform to the material manufacturer's recommendations.

##### 1.5.5.2 Associated Equipment

Associated equipment such as mixer timing equipment, valves, pressure gauges, pressure hoses, other hardware, and tools shall be provided as required to ensure a continuous supply of material and operation control.

#### 1.6 SAMPLE MASONRY PANELS

Sample panels of each procedure proposed for use in the work shall be submitted for approval. No masonry or mortar shall be used in the work until the samples and the represented mixture have been approved.

## 1.7 MATERIAL REQUIREMENTS

### 1.7.1 Strength

Each class or mixture of mortar shall have a 28-day compressive strength matching the compressive strength of the original existing mortar in the structure as determined by ASTM C 109/C 109M for mortar. Test specimens of existing mortar shall be taken from a sound and intact representative portion of the structure, at locations indicated.

### 1.7.2 Special Properties

Mortar may contain admixtures, such as pigments, to match the characteristics of the original mortar. Use of all admixtures shall be subject to approval.

### 1.7.3 Cementitious Content of Mortar

Each class or mixture of mortar shall have a cement content matching the cement content of the original existing mortar in order to provide uniform strength, weathering characteristics, and appearance of repaired surfaces in relation to existing surfaces.

## 1.8 STORAGE OF MATERIALS

Materials shall be stored in weathertight structures which will exclude moisture and contaminants. Cement shall be furnished in suitable bags used for packaging cements. Labeling of packages shall clearly define contents, manufacturer, and batch identification. Detergents, masonry cleaners, paint removers, solvents, epoxies and other chemicals used for masonry cleaning shall be in sealed containers that legibly show the designated name, formula or specification number, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name of manufacturer. Accessories shall be stored avoiding contamination and deterioration. Admixtures which have been in storage onsite for six months or longer, or which have been subjected to freezing, shall not be used unless retested and proven to meet the specified requirements.

## 1.9 SAFETY AND HEALTH

Work shall comply with applicable federal, state, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis, specified in the CONTRACT CLAUSES. The Activity Hazard Analysis shall include analyses of the potential impact of cleaning operations on personnel and on others involved in and adjacent to the work zone.

### 1.9.1 Worker Exposures

Exposure of workers to chemical substances shall not exceed the limits established by ACGIH 0100Doc, or those required by a more stringent applicable regulation.

### 1.9.2 Training

Workers having access to an affected work area shall be informed of the contents of the applicable material safety data sheets, of potential health and safety hazard, and of protective controls associated with materials used on the project. An affected work area is one which may receive dust, mists, and odors from the surface preparation operations. Workers involved in masonry cleaning shall be trained in the safe handling and application, and the exposure limit, of each material to be used in the project. Personnel having a need to use respirators and masks shall be instructed in the use and maintenance of such equipment.

### 1.9.3 Coordination

Work shall be coordinated to minimize exposure of building occupants, other Contractor personnel, and visitors to mists and odors from surface preparation, cleaning, and repair operations.

## 1.10 PROTECTION

Persons, motor vehicles, adjacent surfaces, surrounding buildings, equipment, and landscape materials shall be protected from chemicals used and runoff from cleaning and paint removal operations. Temporary protection covers, which shall remain in operation during the course of the work, shall be erected over pedestrian walkways and at personnel and vehicular points of entrance and exit.

### 1.10.1 Interior Protection

The interior of buildings shall be protected from the weather, cleaning, and repair operations at all times.

### 1.10.2 Environmental Protection

The work shall comply with the requirements of Sections 01355A ENVIRONMENTAL PROTECTION and 13281A LEAD BASED PAINT HAZARD ABATEMENT, TARGET HOUSING & CHILD OCCUPIED FACILITIES.

## 1.11 WEATHER LIMITATIONS

Masonry, mortar, and epoxy adhesives shall not be placed when weather conditions detrimentally affect the quality of the finished product. No masonry or mortar shall be placed when the air temperature is below 40 degrees F in the shade. When air temperature is likely to exceed 90 degrees F masonry and mortar shall have a temperature not exceeding 90 degrees F when deposited. Materials to be used in the work shall be neither produced nor placed during periods of rain or other precipitation. Material placements shall be stopped, and all in-place material shall be protected from exposure, during periods of rain or other precipitation.

## 1.12 WARRANTIES

## 1.12.1 Cleaning Warranty

Cleaning procedures shall be warranted for a period of two years against harm to substrate (masonry and mortar) or to adjacent materials including, but not limited to, discoloration of substrate from improper procedures or usage, chemical damage from inadequate rinse procedures, and abrasive damage from improper procedures.

## 1.12.2 Repair Warranty

Repair procedures, including repointing, shall be warranted for a period of two years against: discoloration or mismatch of new mortar to adjacent original historic mortar, discoloration or damage to masonry from improper mortar clean-up, loss of bond between masonry and mortar, fracturing of masonry edges from improper mortar joint preparation procedures or improper mortar formulation, and occurrence of efflorescence.

## PART 2 PRODUCTS

## 2.1 MATERIALS

Materials, physical and chemical properties, and composition of masonry and mortar used in renovation work shall match that of original existing masonry and mortar to be repaired, unless samples and testing determine that existing mixtures and materials are faulty or non-performing.

## 2.2 CLEANING MATERIALS

## 2.2.1 Paint Removers

Chemical paint removers shall be manufacturer's water soluble, low toxicity products, effective for removal of paint on masonry without altering, damaging, or discoloring the masonry surface.

## 2.2.2 Detergent Cleaners

Detergent cleaners shall be in accordance with BIA Tech Note 20 Rev II..

## 2.2.3 Ionic Cleaners

## 2.2.3.1 Alkaline Prewash Cleaner

Alkaline prewash cleaners shall be as recommended by the manufacturer.

## 2.2.3.2 Two-Part Limestone Cleaner

Two-part limestone cleaners shall be manufacturer's standard, two-part masonry cleaning system consisting of an alkaline prewash cleaner followed by acidic afterwash rinse.

#### 2.2.4 Liquid Strippable Masking Agent

Liquid strippable masking agent shall be manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, and polished stone surfaces from the damaging effect of acidic and alkaline masonry cleaners.

#### 2.2.5 Spray Equipment

Spray equipment for chemical cleaners shall be low-pressure tanks or chemical pumps suitable for chemical cleaner indicated, and shall be equipped with stainless steel, cone-shaped spray-tip. Spray equipment for water shall disperse water through a fan-shaped spray tip at an angle of not less than 15 degrees. Spray equipment shall deliver water at a pressure not greater than 500 psi and at a volume between 2.5 and 3 gpm. Spray equipment for heated water shall be capable of maintaining temperature, at flow rates indicated, between 140 and 180 degrees F.

#### 2.2.6 Cleaning Implements

Brushes shall have natural or nylon fiber bristles only. Wire brushes shall not be used. Scrapers and application paddles shall be made of wood with rounded edges. Metallic tools shall not be used.

#### 2.2.7 Water

Potable water shall be obtained from a local source and shall be filtered to remove minerals resulting in a neutral pH, prior to application. Backflow prevention devices shall be provided at the point of connection to the water supply.

### 2.3 REPAIR MATERIALS

#### 2.3.1 Masonry and Mortar

Masonry and mortar materials used for repair and renovation shall match the original existing historic materials as closely as possible in composition, color, texture, strength, size, finishing and porosity.

#### 2.3.2 Cementitious Materials

Cementitious materials shall be of one type and from one source, when used in mortar which will have surfaces exposed in the finished structure. Cement composition shall match that of cement used in existing mortar to be repaired, as determined by samples and testing, and shall conform to the basic requirements of ASTM C 150, Type I or II, low alkali.

#### 2.3.3 Epoxy Anchor Adhesives

An epoxy-resin grout shall be used to bond steel anchors to masonry, and shall be a 100 percent solids, moisture insensitive, low creep, structural adhesive. The epoxy shall conform to ASTM C 881/C 881M, Type IV; Grade and Class selected to conform to the manufacturer's recommendations for the application.



#### 2.3.4 Metal attachments

Anchors for spall repairs shall be threaded stainless steel, size as indicated. Other plates, angles, anchors, and embedments shall conform to ASTM A 36/A 36M, and shall be prime painted with inorganic zinc primer.

### PART 3 EXECUTION

#### 3.1 EVALUATION AND ANALYSIS

Evaluation and analysis shall conform to the requirements specified herein, and to Section 01451A CONTRACTOR QUALITY CONTROL. Masonry renovation shall be undertaken only after complete evaluation and analysis of the areas to be repaired are completed; this shall include sampling and testing of the existing mortar to determine its composition and qualities. No repair work shall be undertaken until conditions that have caused masonry deterioration have been identified; such conditions shall be corrected, if possible, prior to start of the work.

#### 3.2 MASONRY CLEANING

Historic materials shall not be damaged or marred in the process of cleaning. Cleaning shall conform to BIA Tech Note 20 Rev II. Open joints shall be temporarily caulked or otherwise protected to prevent water and cleaner intrusion into the interior of the structure from pressure spraying. Non-masonry materials and severely deteriorated masonry shall be protected by approved methods prior to initiation of cleaning operations. Masonry cleaning shall remove all organic and inorganic contaminants from the surface and pores of the substrate, returning the masonry to its natural color. Surfaces shall be evenly cleaned with no evidence of streaking or bleaching. The cleaning process shall not affect the density, porosity, or color of the masonry or mortar. Cleaned masonry shall have a neutral pH. Methods used for cleaning historic masonry shall be the gentlest possible to achieve the desired results. Test patches shall be made to determine a satisfactory cleaning result. Cleaning shall proceed in an orderly manner, working from top to bottom of each scaffold width and from one end of each elevation to the other. Cleaning shall be performed in a manner which results in uniform coverage of all surfaces, including corners, moldings, interstices and which produces an even effect without streaking or damage to masonry. The cleaning materials, equipment, and methods shall not result in staining, erosion, marring, or other damage to the surfaces of the structure. Following an initial inspection and evaluation of the structure and surfaces, the structure shall be given a surface cleaning. The surface cleaning shall be completed prior to start of repair work, and sampling and testing of mortars. The cleaning shall provide for the complete cleaning of all exterior masonry surfaces of the structures, removing all traces of moss, dirt, and other contaminants. The cleaning shall provide a clean masonry surface to allow determination of the masonry's color and shades, finish and texture, and other properties. Following completion of the surface cleaning of the structure (or side of structure) the masonry shall be dried prior to the start of any repair work. The following sequence of methods shall be used to determine the least aggressive, effective cleaning method:

1. Water with brushes
2. Water with mild soap
3. Water with stronger soap
4. Water with stronger soap plus ammonia
5. Water with stronger soap plus vinegar (but not on calcareous masonry)
6. Stronger chemical cleaners, only when above methods are determined to be ineffective by the Contracting Officer

#### 3.2.1 Project Conditions

Masonry surfaces shall be cleaned only when air temperatures are above 40 degrees F and will remain so until masonry has dried out, but for not less than 7 days after completion of the work.

#### 3.2.2 Chemical Cleaners

Acidic chemical cleaners shall not be used on limestone, marble, concrete and other calcareous (calcium containing) masonry materials. If chemical cleaners are used on such materials, they shall be alkaline based and utilized with neutralizing afterwashes.

#### 3.2.3 Test Patches

The materials, equipment, and methods to be used in cleaning shall be demonstrated in a test section approximately 3 by 3 ft square. The location of the test section, and the completed test section shall be subject to approval. The cleaning process shall be adjusted as required and the test section rerun until an acceptable process is obtained. Test patches shall be located in inconspicuous areas of the building. The areas tested shall exhibit soiling characteristics representative of those larger areas to be cleaned. Tests shall also be conducted on areas to be stripped of paint. Tested areas shall be allowed to dry before a determination is made on the effectiveness of a particular treatment.

#### 3.2.4 Paint Removal

Paint and other coatings shall be removed from masonry surfaces in areas indicated prior to general cleaning. Masonry shall not be damaged or marred in the process of paint removal. Areas where paint is to be removed shall first be cleaned with water and detergent solution to remove surface dirt, rinsed, and allowed to dry. Chemical paint removers shall be applied in accordance with manufacturer's instructions. Surrounding painted surfaces to remain intact shall be protected from exposure to chemical paint removers to avoid damage. Paint containing lead that is to be removed shall be removed in accordance with Section 13281A LEAD BASED PAINT HAZARD ABATEMENT, TARGET HOUSING & CHILD OCCUPIED FACILITIES.

#### 3.2.5 Water Cleaning

##### 3.2.5.1 Pressure Spraying

Water shall be spray applied to masonry surfaces to comply with requirements indicated by test patches for location, purpose, water

temperature, pressure, volume, and equipment. Unless otherwise indicated, the surface washing shall be done with clean, low pressure water (pressure of less than 55 psi and 2.5 to 3 gpm discharge) and the spray nozzle shall not be held less than 12 inches from surface of masonry. Water shall be applied side to side in overlapping bands to produce uniform coverage.

#### 3.2.5.2 Handscrubbing

Pre-wetted surfaces shall be scrubbed using hand-held natural bristle or nylon brushes. Wire brushes shall not be used. Surfaces to be cleaned shall be scrubbed to remove surface contaminants.

#### 3.2.5.3 Rinsing

Scrubbed surfaces shall be rinsed clean of all contaminants and cleaning solutions with water in a low-to-moderate pressure spray, working upwards from bottom to top of each treated area. The rinsing cycle shall remove all traces of contaminants and cleaning solutions.

#### 3.2.6 Chemical Cleaning

Chemical cleaning of historic masonry shall use the gentlest means possible to achieve the desired result as determined by test patches. Chemical cleaning shall be the use of any product in addition to water, including detergents, ammonia, vinegar, and bleach. Cleaning shall proceed in an orderly manner, working from top to bottom of each scaffold width and from one end of each elevation to the other. Cleaning shall result in uniform coverage of all surfaces, including corners, moldings, interstices and shall produce an even effect without streaking or damage to masonry. Chemical cleaners shall not be applied to the same masonry surfaces more than twice.

##### 3.2.6.1 Surface Prewetting

Masonry surfaces to be cleaned with chemical cleaners shall be wetted with water using a low pressure spray before application of any cleaner.

##### 3.2.6.2 Alkaline Chemical Cleaning - Prewash Phase

Alkaline chemical cleaners shall be applied according to manufacturer's instructions. Alkaline cleaners shall be applied to masonry surfaces by low pressure spray 50 psi max., roller, or brush. Cleaner shall remain on masonry surface for the time period recommended by the manufacturer. Manual scrubbing by brushes shall be employed as indicated by test patches for the specific location. Cleaned surfaces shall be rinsed with a low-to-moderate pressure spray of water.

##### 3.2.6.3 Alkaline Chemical Cleaning - Afterwash Phase

Immediately after rinsing of alkaline cleaned surfaces, a neutralizing afterwash shall be applied to the cleaned masonry areas. Neutralizing afterwash shall be applied according to manufacturer's instructions. Neutralizing afterwash shall be applied to masonry surfaces by low pressure spray 50 psi max., roller, or brush. Afterwash shall remain on masonry

surface for the time period recommended by manufacturer. Cleaned surfaces shall be rinsed with a low-to-moderate pressure spray of water to remove all traces of chemical cleaners.

#### 3.2.6.4 pH Testing

Masonry surfaces which have been chemically cleaned shall be pH tested using pH monitoring pencils or papers. Chemically cleaned masonry shall be rinsed of all chemical residues until a neutral pH (7) reading is obtained from the masonry surface.

### 3.3 MASONRY REPAIR

Repaired surfaces shall match adjacent existing surfaces in all respects. Masonry repair shall proceed only after the cause of deterioration has been identified and corrected. Masonry repair shall conform to ACI C-20. Masonry repair shall proceed only after the area to be repaired has been cleaned. The materials, methods and equipment proposed for use in the repair work shall be demonstrated in test panels. The location, number, size and completed test panels shall be subject to approval. Products shall be used in accordance with the manufacturer's instructions.

#### 3.3.1 Repointing

Repointing work shall be in accordance with BIA Tech Note 20 Rev II. Old caulking, grout, or mortar shall be removed from previously repaired cracks where it is failing. Loose particles shall be removed from cracks. Cracks shall be cleaned, rinsed with water followed by blowing with filtered, dry, compressed air.

##### 3.3.1.1 Mortar Analysis

Existing original historic mortar shall be analyzed before repointing in order to provide a match with the new repointing mortar. Historic mortars are usually softer than newer mortars, often using lime as a binder rather than cement. Lime for repointing mortar shall conform to ASTM C 207, Type S, unless otherwise specified. Full laboratory analysis of the existing mortar shall conform to ASTM C 1324. Field analysis of the existing mortar shall be as specified below.

##### 3.3.1.2 Taking and Preparation of Samples

Samples of unweathered original historic mortar shall be taken and analyzed in order to match the new mortar to be used for repointing. Samples of each different type of mortar in the structure shall be taken and analyzed.

Three or four samples of each type of mortar to be matched shall be removed with a hand chisel from several locations on the building. The largest sample shall be set aside for comparison with the repointing mortar. The remaining samples shall be broken apart with a wooden mallet, powdering them into their constituent parts.

##### 3.3.1.3 Binder Analysis

A part of the sample shall be stirred into diluted hydrochloric acid. If a

vigorous chemical reaction (bubbling) occurs and most of the binder disappears, leaving clean aggregate, the binder was lime. A portland cement binder will result in a murky liquid and will dissolve very slowly over several days.

#### 3.3.1.4 Aggregate Analysis

Aggregate of the mortar sample shall be separated from the binder. This shall be accomplished by taking the crushed mortar sample and either gently blowing away the fine binder material, placing the crushed sample in a centrifuge, or chemically separating the aggregate from the binder. The separated aggregate shall be rinsed clean with water and dried. The aggregate shall be examined with a magnifying glass, and the component materials shall be recorded as to range of materials, sizes, colors, as well as the presence of other materials.

#### 3.3.2 Mechanical Repair

Original historic masonry materials shall be repaired or replaced only if surfaces are extensively deteriorated (surface missing to a depth of 4 inches or more) or are threatening the safety of the structure or individuals. Deteriorated surfaces shall be removed and repaired or replaced only upon approval. Repairs and replacements shall match the materials, colors, and finish of the existing historic masonry as closely as possible.

##### 3.3.2.1 Areas To Be Removed

Unsound, weak, or damaged masonry and mortar shall be removed in areas as indicated. Loose particles, laitance, spalling, cracked, or debonded masonry and mortar and foreign materials shall be removed with hand tools unless otherwise noted. Surfaces prepared for repair shall be cleaned free of dust, dirt, masonry chips, oil or other contaminants, rinsed with water, and dried before repair work is begun. Surfaces of the structure, and surfaces adjacent to the work area shall be protected from damage which may result from removal, cleaning, and repair operations.

##### 3.3.2.2 Application of Masonry and Mortar

Masonry and mortar shall be placed to rebuild spalled or damaged areas to match the original surface finish, level, texture, and color. The finished appearance of the patch shall match the adjacent existing surface.

##### 3.3.2.3 Patch Anchors

Patch anchors shall be provided to ensure that the patch is tied to the existing masonry structure. Patch anchors shall be provided at a frequency of at least one patch anchor per square foot of patch plan surface area; specific locations for patch anchors shall be as indicated. Small handheld, low-speed rotary masonry drills shall be used to produce holes in the existing masonry, within the limits for the patch anchor installation.

#### 3.3.2.4 Holes

Holes shall be drilled into the existing substrate material of the masonry using rotary (non-hammer) drills. Holes shall have a diameter of 1/8 inch larger than the anchor diameter. The holes shall be drilled to a depth of 4 inches, except as otherwise indicated or directed. Drill holes shall not penetrate completely through the masonry, and shall provide at least 1 inch of cover around the drill hole. Holes shall be cleaned by water blasting to remove drill dust and other debris and then blown dry with filtered, dry, compressed air. Drill holes shall be conditioned in accordance with the epoxy adhesive manufacturer's recommendations.

#### 3.3.2.5 Anchor Installation

Anchors shall be cleaned to remove all contaminants which may hinder epoxy bond. Epoxy adhesive shall be pressure injected into the back of the drilled holes. The epoxy shall fill the holes without spilling excess epoxy when the anchors are inserted. Anchors shall be inserted immediately into the holes. The anchors shall be set back from the exterior face at least 1 inch. Anchors shall be installed without breaking or chipping the exposed masonry surface.

#### 3.3.2.6 Cleanup

Excess epoxy and spills shall be removed from the surface of the masonry. The surface of the masonry shall be left in a clean and uncontaminated condition. Spills on adjacent surfaces shall also be removed and surfaces repaired as required.

#### 3.3.2.7 Dutchman Repairs

The piecing-in of small patches of masonry to repair or replace damaged areas (Dutchman repair) shall be used in areas indicated. Repair pieces shall be held in place with epoxy with the joint between the new and old materials kept as narrow as possible to maintain the appearance of a continuous surface. Repairs shall be made to blend in with the surrounding original materials as closely as possible.

### 3.4 EPOXY-RESIN GROUT

The epoxy adhesive shall be conditioned, proportioned, mixed, applied, protected, and cured in accordance with the manufacturer's recommendations, except as otherwise specified herein or indicated on the drawings. The adjacent surfaces and ambient conditions shall be maintained within the manufacturer's recommendations. The patch anchors and epoxy adhesive shall be protected from displacement and disturbances.

#### 3.4.1 Mixing Epoxy-Resin Grout Components

Epoxy-resin grout components shall be mixed in the proportions recommended by the manufacturer. The components shall be conditioned within 70 to 85 degrees F for 48 hours prior to mixing. The two epoxy components shall be mixed with a power-driven, explosion-proof stirring device in a metal or polyethylene container having a hemispherical bottom. The polysulfide

curing agent component shall be added gradually to the epoxy-resin component with constant stirring until a uniform mixture is obtained. The rate of stirring shall be such that the entrained air is at a minimum.

#### 3.4.2 Tools and Equipment

Tools and equipment to be used again in the work shall be cleaned before the epoxy-resin grout sets.

#### 3.4.3 Health and Safety Precautions

Full-face shields shall be provided for mixing, blending, and placing operations as required. Protective coveralls and neoprene-coated gloves shall be provided for workers engaged in the operations. Protective creams of a suitable nature for the operation shall be supplied. Adequate fire protection shall be maintained at mixing and placing operations. Smoking or the use of spark- or flame-producing devices shall be prohibited within 50 feet of mixing and placing operations. The mixing, placing, or storage of epoxy-resin grout or solvent shall be prohibited within 50 feet of any vehicle, equipment, aircraft, or machinery that could be damaged from fire or could ignite vapors from the material.

### 3.5 MASONRY REPLACEMENT

Masonry shall be replaced with material that matches the original in terms of composition, color, texture, strength, finishing, and porosity as closely as possible. If a few isolated masonry units are to be replaced, each shall be removed without disturbing the surrounding masonry. Deteriorated masonry units and mortar requiring replacement shall be removed by hand chiselling. Adjoining masonry units shall not be damaged during the removal of deteriorated units and mortar. The new element shall be tested for fitting into its space without mortar. If wedges are used to support and align the new unit, they shall be covered with at least 1-1/2 inches of mortar when pointing is complete. The four sides and back of the space shall be covered with sufficient mortar to ensure that there will be no air spaces when the new unit is set. The new unit shall be lined up and set by tapping it into place with a wooden or rubber mallet. Face of new unit shall align with that of existing masonry. Joints shall be repointed to match the rest of the wall after new units have been properly installed and adjusted. Replacement areas shall be cleaned with a non-metallic brush and water to remove excess mortar.

### 3.6 MASONRY AND MORTAR FINISHES AND COLOR

The exposed surfaces of masonry and mortar repair shall match the finish, color, texture, and surface detail of the original surface. Mechanical finishing and texturing may be required to produce the required finish and appearance. The finishing and texturing shall conceal bond lines between the repaired area and adjacent surfaces. The texturing shall provide replication of all surface details, including tooling and machine marks. The equipment used in finishing and texturing shall be a low-impact energy type which will not weaken the patch or damage the patch bond and the adjacent concrete.

### 3.7 JOINT SEALING

Joint sealing shall be as specified in Section 07920 JOINT SEALANTS.

### 3.8 FINAL CLEANING

No sooner than 72 hours after completion of the repair work and after joints are sealed, faces and other exposed surfaces of masonry shall be washed down with water applied with a soft bristle brush, then rinsed with clean water. Discolorations which cannot be removed by these procedures, shall be considered defective work. Cleaning work shall be done when temperature and humidity conditions allow the surfaces to dry rapidly. Adjacent surfaces shall be protected from damage during cleaning operations.

### 3.9 PROTECTION OF WORK

Work shall be protected against damage from subsequent operations.

### 3.10 DEFECTIVE WORK

Defective work shall be repaired or replaced, as directed, using approved procedures.

### 3.11 FINAL INSPECTION

Following completion of the work, the structure shall be inspected for damage, staining, and other distresses. The patches shall be inspected for cracking, crazing, delamination, unsoundness, staining and other defects. The finish, texture, color and shade, and surface tolerances of the patches shall be inspected to verify that all requirements have been met. Surfaces exhibiting defects shall be repaired as directed.

-- End of Section --



## SECTION 05090A

WELDING, STRUCTURAL  
12/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 335 (1989) Structural Steel Buildings  
Allowable Stress Design and Plastic Design

## AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A (2001) Recommended Practice

## AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (1998) Standard Symbols for Welding,  
Brazing and Nondestructive Examination

AWS A3.0 (2001) Standard Welding Terms and  
Definitions

AWS D1.1/D1.1M (2002) Structural Welding Code - Steel

AWS Z49.1 (1999) Safety in Welding, Cutting and  
Allied Processes

## 1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

## 1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC 335 unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Qualification testing shall be performed at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

## 1.3.1 Pre-erection Conference

A pre-erection conference shall be held, prior to the start of the field

welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using prequalified procedures). Attendees shall include all Contractor's welding production and inspection personnel and appropriate Government personnel. Items for discussion could include: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

#### 1.3.2 Mock-up Model

The field-welded connection designated as the mock-up model on the drawings shall be the first connection made. All welders qualified and designated to perform field-welded groove joints shall be present during the welding of the mock-up model connections and each one shall perform a part of the welding. The mock-up test shall simulate the physical and environmental conditions that will be encountered during the welding of all groove joints. All inspection procedures required for groove welded joints, including NDE tests, shall be performed on the mock-up model. All Contractor inspection and testing personnel that will perform QC of groove welded joints shall be present during the welding of the mock-up model and each one shall perform the inspection procedures to be performed on production welding of these joints. This mock-up model connection shall be the standard of performance, both for the welding and inspection procedures used and the results to be achieved in the production welding for these groove welded joints.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-03 Product Data

Welding Procedure Qualifications; G, A/E.  
Welder, Welding Operator, and Tacker Qualification  
Inspector Qualification  
Previous Qualifications  
Prequalified Procedures

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

##### SD-06 Test Reports

##### Quality Control

A quality assurance plan and records of tests and inspections.

## 1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1/D1.1M and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1/D1.1M. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

### 1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

- a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

### 1.5.2 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS D1.1/D1.1M will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

### 1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

## 1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

### 1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions are met:

- a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.
- b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

### 1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

### 1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

- a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.
- b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.
- c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.
- d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific

reason to question the tacker's ability. In such a case, the tacker shall be required to pass the prescribed tack welding test.

#### 1.7 INSPECTOR QUALIFICATION

Inspector qualifications shall be in accordance with AWS D1.1/D1.1M. Nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

#### 1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

#### 1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

### PART 2 PRODUCTS

#### 2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

### PART 3 EXECUTION

#### 3.1 WELDING OPERATIONS

##### 3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1/D1.1M and AISC 335. When AWS D1.1/D1.1M and the AISC 335 specification conflict, the requirements of AWS D1.1/D1.1M shall govern.

##### 3.1.2 Identification

Welds shall be identified in one of the following ways:

- a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.
- b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers shall not be allowed.

### 3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. The Contractor shall perform visual and radiographic, inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1/D1.1M, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," shall be employed.

### 3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Nondestructive testing shall be by visual inspection and radiographic, methods. The minimum extent of nondestructive testing shall be random 25 percent of welds or joints, as indicated on the drawings.

#### 3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

#### 3.3.2 Destructive Tests

When metallographic specimens are removed from any part of a structure, the Contractor shall make repairs. The Contractor shall employ qualified welders or welding operators, and shall use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

### 3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

### 3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a

defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to ensure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

## SECTION 05120

STRUCTURAL STEEL  
**08/03**

## PART 4 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO HB-17 (2002) Standard Specifications for Highway Bridges

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303 (2000) Code of Standard Practice for Steel Buildings and Bridges

AISC 316 (1989) ASD Manual of Steel Construction

AISC 317 (1992) ASD Manual of Steel Construction, Vol II: Connections

AISC 325 (2001) LRFD Manual of Steel Construction

AISC 326 (2002) Detailing for Steel Construction

AISC 335 (1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AISC 341 (2002) Seismic Provisions for Structural Steel Buildings

AISC 348 (2000) Structural Joints Using ASTM A325 or A490 Bolts

AISC 350 (1999) Load and Resistance Factor Design (LRFD) Specification for Structural Steel Buildings

AISC 810 (1997) Design Guide 10: Erection Bracing of Low-Rise Structural Steel Frames/Fisher and West

AISC FCD (1995a) AISC Quality Certification Program



AISC M018L	(1999) LRFD Manual of Steel Construction, Metric Conversion Volume I
AISC M019L	(1999) LRFD Manual of Steel Construction, Metric Conversion Volume II
AISC S340	(1992) Metric Properties of Structural Shapes with Dimensions According to ASTM A6M

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION  
(AREMA)

AREMA Manual	(2003) Manual for Railway Engineering
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AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2002) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	(1995) Surface Texture, (Surface Roughness, Waviness and Lay)
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ASTM INTERNATIONAL (ASTM)

ASTM A 108	(1999) Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 143	(2003) Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A 153/A 153M	(2003) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 242/A 242M	(2003a) High-Strength Low-Alloy Structural Steel
ASTM A 307	(2002) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2002) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2003) Structural Bolts, Steel, Heat

	Treated, 830Mpa Minimum Tensile Strength (Metric)
ASTM A 36/A 36M	(2003a) Carbon Structural Steel
ASTM A 490	(2002) Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 490M	(2003) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(2003) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2001) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 514/A 514M	(2000a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(2003) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2000) Carbon and Alloy Steel Nuts
ASTM A 563M	(2001) Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M	(2003a) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(2003) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 6/A 6M	(2003a) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 618	(2001) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 668/A 668M	(2003) Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 709/A 709M	(2003a) Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges

ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 852/A 852M	(2003) Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick
ASTM A 992/A 992M	(2002) Steel for Structural Shapes for Use in Building Framing
ASTM B 695	(2000) Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C 1107	(2002) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 827	(2001a) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM F 436	(2003) Hardened Steel Washers
ASTM F 436M	(2003) Hardened Steel Washers (Metric)
ASTM F 844	(2000) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(2002) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM F 959M	(2002) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

## CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70	(2000) Top Running and Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes, No. 70
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## THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC PS 13.01	(1982; R 2000) Epoxy-Polyamide Painting System
SSPC Paint 25	(1997; R 2000) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

SSPC SP 3 (1982; R 2000) Power Tool Cleaning

SSPC SP 6 (2000) Commercial Blast Cleaning

## 1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including [shop primer] [galvanizing], complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with [AISC 316 and AISC 317] [AISC 325] except as modified in this contract.

## 1.3 MODIFICATIONS TO REFERENCES

[In [AISC 316, AISC 317, AISC 335, AISC 303, AISC 348, and AISC S340, except as modified in this section, shall be considered a part of AISC 316 and AISC 317 and is referred to in this section as AISC 316 and AISC 317.]]

[In [AISC 325, AISC 350, AISC 303, AISC 348, and AISC S340, except as modified in this section, shall be considered a part of AISC M018L and AISC M019L and is referred to in this section as AISC 325.]]

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

[Erection Plan, including description of temporary supports; G]

[Fabrication drawings including description of connections; G]

### SD-03 Product Data

Shop primer

Load indicator washers

[Load indicator bolts]

Include test report for Class B primer.

### SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Shop primer

Welding electrodes and rods

Nonshrink grout

[Galvanizing]

[Pins and rollers]

[AISC Quality Certification]

Overhead, top running crane rail beam

Welding procedures and qualifications

[1.5 AISC QUALITY CERTIFICATION

Work shall be fabricated in an AISC certified Category [Sbd] [\_\_\_\_\_] fabrication plant.

][1.6 SEISMIC PROVISIONS

In addition to AISC 325, the structural steel system shall be provided in accordance with AISC 341.

]1.7 QUALITY ASSURANCE

1.7.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326, AISC 316 and AISC 317. Drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. [Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes[, with calculations,] as part of the drawings.]

### 1.7.2 Certifications

#### 1.7.2.1 Overhead, Top Running Crane Rail Beam

Submit written field survey results for overhead, top running crane rail beam verifying tolerance requirements, area out of tolerance and proposed corrective measures.

#### 1.7.2.2 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

#### 1.7.2.3 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

## PART 2 PRODUCTS

### 2.1 STEEL

#### 2.1.1 Structural Steel

ASTM A 36/A 36M.

#### 2.1.2 High-Strength Structural Steel

##### 2.1.2.1 Low-Alloy Steel

ASTM A 572/A 572M [, Grade [\_\_\_\_]]. [ASTM A 992/A 992M [Grade [\_\_\_\_]]][  
ASTM A 709/A 709M [Grade [\_\_\_\_]]].

##### 2.1.2.2 Quenched and Tempered Alloy Steel

ASTM A 514/A 514M [, Grade [\_\_\_\_]].

##### 2.1.2.3 Quenched and Tempered Low-Alloy Steel

ASTM A 852/A 852M, 70 ksi.

#### 2.1.3 Weathering Structural Steel

ASTM A 242/A 242M, Type 1; ASTM A 588/A 588M.

#### 2.1.4 Structural Grade Carbon-Manganese Steel

ASTM A 529/A 529M, high strength carbon-manganese steel of structural quality.

#### 2.1.5 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A 992/A 992M.

#### 2.1.6 Structural Steel Tubing

ASTM A 500, Grade [B] [\_\_\_\_]; ASTM A 501; [ASTM A 618, Grade [\_\_\_\_]].

#### 2.1.7 Steel Pipe

ASTM A 53, Type E or S, Grade B, weight class [STD (Standard)] [\_\_\_\_].

### 2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

#### 2.2.1 Structural Steel [, Steel Pipe]

##### 2.2.1.1 Bolts

ASTM A 307, Grade A; [ ASTM A 325, Type 1], [ ASTM A 490, Type 1]. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

##### 2.2.1.2 Nuts

ASTM A 563, Grade and Style for applicable ASTM bolt standard recommended.

##### 2.2.1.3 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436 washers for ASTM A 325 and ASTM A 490 bolts.

#### 2.2.2 High-Strength Structural Steel [and Structural Steel Tubing]

##### 2.2.2.1 Bolts

ASTM A 325, Type 1 ASTM A 490, Type 1 or 2.

##### 2.2.2.2 Nuts

ASTM A 563, Grade and Style as specified in the applicable ASTM bolt standard.

##### 2.2.2.3 Washers

ASTM F 436, plain carbon steel.

### 2.2.3 Weathering Structural Steel

#### 2.2.3.1 Bolts

ASTM A 325, Type 3; ASTM A 490, Type 3.

#### 2.2.3.2 Nuts

ASTM A 563, heavy hex style, Grade DH3, except Grade C3 may be furnished for ASTM A 325 bolts.

#### 2.2.3.3 Washers

ASTM F 436, weathering steel.

### 2.2.4 Foundation Anchorage

#### 2.2.4.1 Bolts

ASTM A 307.

#### 2.2.4.2 Nuts

ASTM A 563, Grade A, hex style.

#### 2.2.4.3 Washers

ASTM F 844.

### 2.2.5 Load Indicator Washers

ASTM F 959. [Provide ASTM B 695, Class 50, Type 1 galvanizing.]

### [2.2.6 Load Indicator Bolts

ASTM A 325, Type 1; ASTM A 490, Type 1, with a manufactured notch between the bolt tip and threads. The bolt shall be designed to react to the opposing rotational torques applied by the installation wrench, with the bolt tip automatically shearing off when the proper tension is obtained.

### ]2.2.7 Self-Locking Nuts

Provide nuts with a locking pin set in the nut. The locking pin shall slide along the bolt threads, and by reversing the direction of the locking pin, the nut shall be removed without damaging the nut or bolt. Provide stainless steel locking pins.

### ]2.3 STRUCTURAL STEEL ACCESSORIES

#### 2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.



## 2.3.2 Nonshrink Grout

ASTM C 1107, with no ASTM C 827 shrinkage. [Grout shall be nonmetallic.]

## 2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

## [2.3.4 Pins and Rollers

ASTM A 668/A 668M, Class C, D, F, or G; ASTM A 108, Grades 1016 to 1030. Provide as specified in AASHTO HB-17, Division II, Sections 10.26 and 10.27, except provide pins in lengths to extend a minimum of 0.25 inch beyond the outside faces of the connected parts.

## ]2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 316 and AISC 317 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

## [2.5 GALVANIZING

ASTM A 123/A 123M or ASTM A 153/A 153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

## ][2.6 OVERHEAD, TOP RUNNING CRANE RAIL

[AISC 316 and AISC 317] [AISC 325] [AREMA Manual], [\_\_\_\_\_] pound crane rail section and [bolted] [welded] joints. Provide rail fasteners and a minimum rail length of 10 feet.

## ]2.7 FABRICATION

## 2.7.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded [or on surfaces of weathering steels that will be exposed in the completed structure]. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. [Affix embossed tags to hot-dipped galvanized members.]

## 2.7.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, [surfaces to receive sprayed-on fireproofing,] [surfaces to receive epoxy coatings,] [surfaces designed as part of a composite steel concrete section,] or surfaces within 0.5 inch of the toe of the welds

prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer.

#### 2.7.2.1 Cleaning

SSPC SP 6, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

#### 2.7.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

#### [2.7.3 [Fireproofing] [and] [Epoxy] Coated Surfaces

Surfaces to receive [sprayed-on fireproofing] [epoxy] coatings shall be cleaned and prepared in accordance with the manufacturer's recommendations, and as specified in Section [07810 SPRAY-APPLIED FIREPROOFING] [\_\_\_\_], ["\_\_\_\_\_"].

#### ] [2.7.4 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

### ] PART 3 EXECUTION

#### 3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 316. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC FCD for Category [\_\_\_\_] [Supplement] structural steelwork. Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inches as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with [endorsement "P" of AISC FCD] [\_\_\_\_] and primed with the specified paint.

### 3.2 INSTALLATION

#### [3.2.1 Overhead, Top Running Cranes

Runway rails and beams shall be provided in accordance with [AISC 316 and AISC 317] [AISC 325] and CMAA 70, except that in case of conflict, the requirements of CMAA 70 shall govern. In addition, provide a maximum vertical difference of 0.03 inch in the elevation between adjacent runway rail tops and adjacent runway beam tops at joints. Provide adjustable runway support connections to allow placement of the crane rails and beams to the tolerances specified. Stagger runway rail joints a minimum of one foot, except that the stagger shall not be the same as the crane wheel spacing.

#### ]3.3 ERECTION

- a: Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of [AISC 316] [AISC 325] [endorsement F of AISC FCD]. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.
- b. For low-rise structural steel buildings ( 60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC 303 and the structure shall be erected in accordance with AISC 810.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

#### 3.3.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

### 3.4 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with [AISC 335] [AISC 350]. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt [and pin] holes. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

#### 3.4.1 Common Grade Bolts

ASTM A 307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

### 3.4.2 High-Strength Bolts

ASTM A 325 and ASTM A 490 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. [Provide load indicator bolts or washers in all [ ASTM A 325M] [or] [ ASTM A 490] bolted connections, except provide only load indicator washers for slip critical connections. Direct tension indicator tightening, [, or installation of alternate design fasteners,] shall be the only acceptable tightening methods. Use only direct tension indicator tightening for slip critical connections.] Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

#### 3.4.2.1 Installation of Load Indicator Washers (LIW)

ASTM F 959. Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F 436 washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat ASTM F 436 washers under both the bolt head and nut when ASTM A 490 bolts are used.

### 3.5 WELDING

AWS D1.1/D1.1M[, except use only shielded metal arc welding and low hydrogen electrodes for ASTM A 514/A 514M steel. Do not stress relieve ASTM A 514/A 514M steel by heat treatment]. [Grind exposed welds smooth as indicated.] Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

The contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

#### 3.5.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

[Removal is not required] [Remove only from finished areas].

### 3.6 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

#### 3.6.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

## [3.7 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

## ]3.8 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing[, except that electric power for field tests will be furnished as set forth in Division 1]. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

## 3.8.1 Welds

## 3.8.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

## 3.8.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be [as indicated] [selected by the Contracting Officer]. If more than [20] [\_\_\_\_\_] percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

- a. Testing frequency: Provide the following types and number of tests:

<u>Test Type</u>	<u>Number of Tests</u>
Radiographic	[_____]
Ultrasonic	[_____]
Magnetic Particle	[_____]
Dye Penetrant	[_____]

### 3.8.2 Load Indicator Washers

#### 3.8.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005 inch gap when the load indicator washer is placed under the turned element, as required by ASTM F 959.

#### [3.8.2.2 Load Indicator Gaps

In addition to the above testing, an independent testing agency as approved by the Contracting Officer, shall test in place the load indicator gapson 20 percent of the installed load indicator washers to verify that the ASTM F 959 load indicator gaps have been achieved. If more than 10 percent of the load indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F 959, then all in place load indicator washers shall be tested to verify that the ASTM F 959 load indicator gaps have been achieved. Test locations shall be selected by the Contracting Officer.

#### ]3.8.3 Overhead, Top Running Crane Rails and Beams

Runway rails and beams shall be surveyed (horizontally and vertically) after installation to verify compliance with the tolerance requirements of CMAA 70 and the additional tolerance requirements specified in this section. After each survey, submit a written report to the Contracting Officer with the following information: field survey results, tolerance requirements, areas out of tolerance, and proposed corrective measures. Proposed corrective measures shall be approved by the Contracting Officer. Following completion of corrective measures, areas that were previously out of tolerance shall be re-surveyed and another written report shall be furnished to the Contracting Officer. Field surveys shall be performed and sealed by a registered land surveyor.

#### ]3.8.4 High-Strength Bolts

##### 3.8.4.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of [3] [\_\_\_\_\_] bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in [AISC 348] [AISC 348], Table 4, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

##### 3.8.4.2 Inspection

Inspection procedures shall be in accordance with [AISC 348] [AISC 348], Section 9. Confirm and report to the Contracting Officer that the

materials meet the project specification and that they are properly stored.

Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

#### 3.8.4.3 Testing

The Government has the option to perform nondestructive tests on [5] [\_\_\_\_\_] percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than [10] [\_\_\_\_\_] percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

#### [3.8.5 Testing for Embrittlement

ASTM A 143 for steel products hot-dip galvanized after fabrication.

#### ]3.9 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452A SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --

## SECTION 05500A

MISCELLANEOUS METAL  
**01/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ALUMINUM ASSOCIATION (AA)

AA DAF-45 (2003) Designation System for Aluminum  
Finishes

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3 (2002) Standard for Fixed Ladders and  
Safety Requirements

## AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2002) Minimum Design Loads for Buildings  
and Other Structures

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (2002) Structural Welding Code - Steel

## ASTM INTERNATIONAL (ASTM)

ASTM A 123 (2002) Zinc (Hot-Dip Galvanized) Coatings  
on Iron and Steel Products

ASTM A 283 (2003) Low and Intermediate Tensile  
Strength Carbon Steel Plates

ASTM A 36 (2003a) Carbon Structural Steel

ASTM A 467 (2001) Machine and Coil Chain

ASTM A 475 (1998) Zinc-Coated Steel Wire Strand

ASTM A 53 (2002) Pipe, Steel, Black and Hot-Dipped,  
Zinc-Coated, Welded and Seamless

ASTM A 653 (2003) Steel Sheet, Zinc-Coated  
(Galvanized) or Zinc-Iron Alloy-Coated



(Galvannealed) by the Hot-Dip Process

ASTM B 221 (2002) Aluminum and Aluminum-Alloy  
Extruded Bars, Rods, Wire, Profiles, and  
Tubes

ASTM F 1267 (2001) Metal, Expanded, Steel

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531 (2000) Metal Bar Grating Manual

NAAMM MBG 532 (2000) Heavy Duty Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10 (2002) Portable Fire Extinguishers

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-344 (Rev B) Lacquer (Clear Gloss)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Miscellaneous Metal Items G, A/E.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: Duct Supports and electrical lighting, sound system, and acustical elements.

### S-04 Samples

Miscellaneous Metal Items  
Duct Supports, Toilets, Pipes and Shafts.

## 1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM

A 123, ASTM A 653, or ASTM A 924, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

#### 1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

#### 1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

#### 1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

#### 1.7 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have standard mill finish.

The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish. Aluminum surfaces to be in contact with plaster or concrete during construction shall be protected with a field coat conforming to CID A-A-344.

#### 1.8 SHOP APPLIED PRIME COAT

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless

otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

## PART 2 PRODUCTS

### 2.1 ACCESS DOORS AND PANELS

Doors and panels shall be flush type unless otherwise indicated. Frames for access doors shall be fabricated of not lighter than 16 gauge steel with welded joints and finished with anchorage for securing into construction. Access doors shall be a minimum of 14 by 20 inches and of not lighter than 14 gauge steel, with stiffened edges, complete with attachments. Access doors shall be hinged to frame and provided with a flush face, screw driver operated latch. Exposed metal surfaces shall have a shop applied prime coat. At acoustically- significant construction provide gypsum board backing for access panels equal to the weight of the wall or ceiling and neoprene gasketing to create an airtight system.

### 2.2 HANDRAILS

Handrails shall be designed to resist a concentrated load of 200 pounds in any direction at any point of the top of the rail or 20 pounds per foot applied horizontally to top of the rail, whichever is more severe.

#### 2.2.1 Steel Handrails, Including Carbon Steel Inserts

Steel handrails, including inserts in concrete, shall be structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength. Steel railings shall be 1-1/2 inch nominal size. Railings shall be shop primed. Pipe collars shall be steel.

- a. Joint posts, rail, and corners shall be fabricated by one of the following methods:

- (1) Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal recessed-head setscrews.

- (2) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 6 inches long.

- (3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

- b. Removable sections, toe-boards, and brackets shall be provided as indicated.

### 2.3 GUY CABLES

Guy cables shall be prestretched, galvanized wire rope of the sizes

indicated. Wire rope shall conform to ASTM A 475, high strength grade with Class A coating. Guys shall have a factory attached clevis top-end fitting; guys shall have a factory attached open-bridge strand socket bottom-end fitting; guys shall be complete with oval eye, threaded anchor rods. Fittings and accessories shall be hot-dip galvanized.

#### 2.4 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

#### 2.5 SAFETY CHAINS

Safety chains shall be galvanized welded steel, proof coil chain tested in accordance with ASTM A 467/A 467M, Class CS. Safety chains shall be straight link style, 3/16 inch diameter, minimum 12 links per foot and with bolt type snap hooks on each end. Eye bolts for attachment of chains shall be galvanized 3/8 inch bolt with 3/4 inch eye, anchored as indicated. Two chains shall be furnished for each guarded opening.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

#### 3.2 REMOVABLE ACCESS PANELS

A removable access panel not less than 12 by 12 inches shall be installed directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

#### 3.3 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

##### 3.3.1 Installation of Steel Handrails

Installation shall be by means of pipe sleeves secured to masonry with expansion shields and bolts or toggle bolts. Rail ends shall be secured by steel pipe flanges anchored by expansion shields and bolts.

#### 3.4 ERECTION OF GUY CABLES

Guy cables shall be erected as indicated. Anchor rods shall be cast in concrete located and reinforced as shown.

3.5 MOUNTING OF SAFETY CHAINS

Safety chains shall be mounted 3 feet 6 inches and 2 feet above the floor.

-- End of Section --

## SECTION 06100A

ROUGH CARPENTRY  
**02/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN FOREST &amp; PAPER ASSOCIATION (AF&amp;PA)

- |            |   |
|------------|---|
| AF&PA T101 | (1991; Supple 1993; Addenda Apr 1997; Supple T02) National Design Specification for Wood Construction |
| AF&PA T10  | (2001) Wood Frame Construction Manual for One- and Two-Family Dwellings                               |

## AMERICAN HARDBOARD ASSOCIATION (AHA)

- |            |                               |
|------------|-------------------------------|
| AHA A135.4 | (1995) Basic Hardboard        |
| AHA A194.1 | (1985) Cellulosic Fiber Board |

## AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

- |             |  |
|-------------|--|
| AITC 109    | (1990) Standard for Preservative Treatment of Structural Glued Laminated Timber                                      |
| AITC 111    | (1979) Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection |
| AITC A190.1 | (1992) Wood Products - Structural Glued Laminated Timber   |
| AITC OT-01  | (1994) Timber Construction Manual  |

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |             |                                       |
|-------------|---------------------------------------|
| ANSI A208.1 | (1999) Particleboard Mat Formed Woods |
|-------------|---------------------------------------|

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |             |  |
|-------------|--|
| ASTM A 307  | (2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength |
| ASTM C 1136 | (1995) Flexible, Low Permeance Vapor                             |

## Retarders for Thermal Insulation

ASTM C 1177/C 1177M	(1999) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 208	(1995) Cellulosic Fiber Insulating Board
ASTM C 516	(1980; R 1996el) Vermiculite Loose Fill Thermal Insulation
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 549	(1981; R 1995el) Perlite Loose Fill Insulation
ASTM C 552	(2000) Cellular Glass Thermal Insulation
ASTM C 553	(1999) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(2000) Mineral Fiber Block and Board Thermal Insulation
ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 726	(2000) Mineral Fiber Roof Insulation Board
ASTM C 739	(2000) Cellulosic Fiber (Wood-Base) Loose-Fill Thermal Insulation
ASTM C 764	(1999) Mineral Fiber Loose-Fill Thermal Insulation
ASTM C 79/C 79M	(2000) Treated Core and Nontreated Core Gypsum Sheathing Board
ASTM D 2898	(1994; R 1999) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing

ASTM D 3498	(1999) Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
ASTM E 154	(1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000) Water Vapor Transmission of Materials
ASTM F 547	(1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and Wood-Based Materials

## AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2	(2000) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C20	(1999) Structural Lumber Fire-Retardant Pressure Treatment
AWPA C27	(1999) Plywood - Fire-Retardant Pressure Treatment
AWPA C9	(1997) Plywood - Preservative Treatment by Pressure Processes
AWPA M4	(1999) Standard for the Care of Preservative-Treated Wood Products
AWPA P5	(2000) Standards for Waterborne Preservatives

## APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA EWS R540C	(1996) Builder Tips Proper Storage and Handling of Glulam Beams
APA EWS T300E	(2002) Technical Note: Glulam Connection Details
APA E445S	(2001; R 2002) Performance Standards and Policies for Structural-Use Panels (APA PRP-108)

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM DS 1-49	(2000) Perimeter Flashing
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NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules (1994) Rules for the Measurement &  
Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules (1997) Standard Grading Rules for  
Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS)

RIS Grade Use (1997) Grades of California Redwood Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec (1986; Supple No. 1, Aug 1993) Standard  
Specifications for Grades of Southern  
Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003 (1994; Supple 8 thru 11) Standard Grading  
Rules for Southern Pine Lumber

TRUSS PLATE INSTITUTE (TPI)

TPI 1 (1995; Errata) National Design Standard  
for Metal Plate-Connected Wood Truss  
Construction and Commentary; and Appendix 1

TPI HIB (1991) Handling, Installing and Bracing of  
Metal Plate Connected Wood Trusses

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1 (1995) Construction and Industrial Plywood

PS2 (1993) Wood-Base Structural-Use Panels

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1209 Interim Safety Standard for Cellulose  
Insulation

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (1996; Supp. VII & VIII) Standard Grading  
and Dressing Rules for Douglas Fir,  
Western Hemlock, Western Red Cedar, White  
Fir, Sitka Spruce Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5

(1999) Western Lumber Grading Rules 95

1.2 SUBMITTALS

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SD-07 Certificates

Grading and Marking ,

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Insulation ,

Certificate attesting that the cellulose, perlite, glass and mineral fiber, glass mat gypsum roof board, polyurethane, or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity. Laminated timber shall be handled and stored in accordance with AITC 111 or APA EWS R540C.

PART 2 PRODUCTS

2.1 LUMBER AND SHEATHING

2.1.1 Grading and Marking

2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

#### 2.1.1.2 Plywood and Other Sheathing Products

Materials shall bear the grademark or other identifying marks indicating grades of material and rules or standards under which produced, including requirements for qualifications and authority of the inspection organization. Except for plywood and wood structural panels, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

#### 2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

#### 2.1.3 Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil. Except as specified for all-heart material of the previously mentioned species, the following items shall be treated:

- a. Wood members in contact with or within 18 inches of soil.
- b. Wood members in contact with water.
- c. Wood members exposed to the weather and those used in roofing systems or as nailing strips or nailers over fiberboard or gypsum-board wall sheathing as a base for wood siding.
- d. Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
- e. Wood members in contact with concrete that is in contact with soil or water or that is exposed to weather.

##### 2.1.3.1 Lumber and Timbers

Lumber and timbers shall be treated in accordance with AWPA C2 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

- a. 0.25 pcf intended for above ground use.
- b. 0.40 pcf intended for ground contact and fresh water use.

##### 2.1.3.2 Plywood

Plywood shall be treated in accordance with AWPA C9 with waterborne

preservatives listed in AWPAP5 to a retention level as follows:

- a. 0.25 pcf intended for above ground use.
- b. 0.40 pcf intended for ground contact and fresh water use.

#### 2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

- a. Treated and Untreated Lumber Except Roof Planking: 4 inches or less, nominal thickness, 19 percent maximum. 5 inches or more, nominal thickness, 23 percent maximum in a 3 inch perimeter of the timber cross-section.
- b. Roof Planking: 15 percent maximum.
- c. Materials Other Than Lumber: In accordance with standard under which product is produced.

#### 2.1.5 Structural Wood Members

Species and grades shall be as listed in AF&PA T101. Design of members and fastenings shall conform to AITC OT-01. Other stress graded or dimensioned items such as blocking, carriages, and studs shall be standard or No. 2 grade except that studs may be Stud grade.

#### 2.1.6 Subflooring

##### 2.1.6.1 Plywood

Plywood shall conform to PS1, APA E445S or PS2; Grade C-D or Sheathing grade with exterior glue for uses not otherwise specified; Grade C-D or sheathing grade with exterior glue for reception of underlayment or wood flooring; underlayment grade with exterior glue, or C-C (plugged) exterior grade for use as a combination subfloor-underlayment under resilient flooring. Minimum span rating for subflooring shall be 24/16 for supports 16 inches on center, and 48/24 for supports 24 inches on center. Minimum span rating for combination subfloor-underlayment shall be 16/0 for supports 16 inches on center and 24/0 for supports at 24 inches on center.

##### 2.1.6.2 Wood Structural Panels

Rated wood structural panels shall be qualified for subflooring or combination subfloor-underlayment under APA E445S or PS2. Subflooring shall be rated sheathing with a span rating of 24/16 or greater for supports 16 inches on center and shall have span rating of 48/24 or greater for supports 24 inches on center. Combination subfloor-underlayment shall have a span rating of 16/0 or greater for supports 16 inches on center and shall have span rating for 24/0 or greater for supports 24 inches on center.

## 2.1.6.3 Wood

Species and grade shall be in accordance with TABLE I at the end of this section, 1 inch thick, center-matched, shiplapped, or square edge.

## 2.1.7 Underlayment

Underlayment shall conform to the following:

## 2.1.7.1 Plywood

Plywood shall conform to PS1, underlayment grade with exterior glue, or C-C (Plugged) exterior grade 11/32 inch thick, 4 feet wide.

## 2.1.8 Roof Decking

Roof decking shall be select grade with minimum design value of 1100 psi in bending. Decking shall be 2 inches thick with single tongue and groove ; V-jointed, matched and dressed. As an option, fabricated laminated lumber decking with interlocking tongue and groove joints may be provided.

## 2.1.9 Miscellaneous Wood Members

## 2.1.9.1 Nonstress Graded Members

Members shall include bridging, corner bracing, furring, grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size (inch)
Bridging	1 x 3 or 1 x 4 for use between members 2 x 12 and smaller; 2 x 4 for use between members larger than 2 x 12.
Corner bracing	1 x 4.
Furring	1 x 2 .
Grounds	Plaster thickness by 1-1/2.
Nailing strips	1 x 3 or 1 x 4 when used as shingle base or interior finish, otherwise 2 inch stock.

## 2.1.9.2 Wood Bumpers

Bumpers shall be of the species and grade in accordance with TABLE II at the end of this section, size as shown.

## 2.1.9.3 Sill Plates

Sill plates shall be standard or number 2 grade.

#### 2.1.9.4 Blocking

Blocking shall be standard or number 2 grade.

#### 2.1.9.5 Rough Bucks and Frames

Rough bucks and frames shall be straight standard or number 2 grade.

### 2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

#### 2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

#### 2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

#### 2.2.3 Clip Angles

Steel, 3/16 inch thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

#### 2.2.4 Expansion Shields

Type and size best suited for intended use.

#### 2.2.5 Joist Hangers

Steel or iron, zinc-coated, size to fit members where used, sufficient strength to develop the full strength of supported member, complete with any special nails required.

#### 2.2.6 Metal Bridging

Optional to wood bridging; zinc-coated steel, size and design to provide rigidity equivalent to specified wood bridging.

#### 2.2.7 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For sheathing and subflooring, length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T10. Where detailed nailing requirements are

not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T101. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

### PART 3 EXECUTION

#### 3.1 INSTALLATION OF FRAMING

##### 3.1.1 General

General framing shall be in accordance with AF&PA T10. Members shall be closely fitted, accurately set to required lines and levels, and rigidly secured in place. Members shall be framed for passage of ducts. Members shall be cut, notched, or bored in accordance with applicable requirements of AF&PA T101 for the passage of pipes, wires, or conduits. Rafters, purlins, and joists shall be set with crown edge up. Framing shall be kept at least 2 inches away from chimneys and 4 inches away from fireplace backwalls. When joists, beams, and girders are placed on masonry or concrete, a wood base plate shall be positioned and leveled with grout. The joist, beam, or girder shall then be placed on the plate. When joists, beams, and girders are set into masonry or concrete, a pocket shall be formed into the wall. The joist, beam, or girder shall then be placed into the pocket and leveled with a steel shim.

##### 3.1.2 Partition and Wall Framing

Unless otherwise shown, studs shall be spaced 16 inches on centers. Studs shall be doubled at openings. Unless otherwise indicated, headers for openings shall be made of two pieces of stud material set on edge or solid lumber of equivalent size, and corners shall be constructed of not less than three full members. End studs of partitions abutting concrete or masonry shall be anchored thereto with expansion bolts, one near each end of each stud and at intermediate intervals of not more than 4 feet. Plates of partitions resting on concrete floors shall be anchored in place with expansion bolts, one near each end of each piece and at intermediate intervals of not more than 6 feet between bolts. In lieu of expansion bolts, anchoring into concrete may be accomplished with powder-driven threaded studs of suitable type and size and spaced at 3 feet on center. Walls and load bearing partitions shall be provided with double top plates with members lapped at least [2] [4] feet and well spiked together.

##### 3.1.3 Floor (Ceiling) Framing

Except where otherwise indicated joists shall have bearings not less than 4 inches on concrete or masonry and 1-1/2 inches on wood or metal. Joists, trimmers, headers, and beams framing into carrying members at the same relative levels shall be carried on joist hangers. Joists shall be lapped and spiked together at bearings or butted end-to-end with scab ties at joint and spiked to plates. Openings in floors shall be framed with headers and trimmers. Headers carrying more than two tail joists and trimmers supporting headers carrying more than one tail joist shall be

doubled, unless otherwise indicated. Joists shall be doubled under partitions parallel with floor joists. Joists built into masonry shall be provided with [a beveled fire cut so that the top of the joist does not enter the wall more than 1 inch] [or] [standard steel wall bearing boxes].

Engineered wood joists shall be installed in accordance with distributor's instructions.

#### 3.1.4 Stair Framing

Stair framing members shall be well spiked together. Rough carriages shall be cut to exact shape required to receive finish treads and risers. Risers shall be of uniform height, and treads shall be of uniform width except as otherwise shown. Trimmers, blocking, and other framing necessary for support of finish treads, risers, newels, and railing shall be provided.

### 3.2 INSTALLATION OF SUBFLOORING

#### 3.2.1 Plywood and Wood Structural Panel

Subflooring shall be applied with long dimension at right angles to the supports, with edges 1/8 inch apart at side and end joints, and nailed at supported edges 6 inches on center and at intermediate supports 12 inches on center unless otherwise shown. Subflooring may be installed with adhesive conforming to ASTM D 3498 and nails spaced at 12 inches on center unless otherwise shown. Each panel shall have end joints made over supports and end joints staggered. Where finish flooring of different thicknesses is used in adjoining areas, wood strips of the thickness required to bring the finish flooring surfaces into the same plane shall be used under the plywood subfloor.

### 3.3 INSTALLATION OF UNDERLAYMENT

#### 3.3.1 Plywood

Underlayment shall be applied with edges 1/32 inch apart at joints and nailed at edges 6 inches on center and at 8 inches on center throughout remainder of panel for panels 11/32 inch and thicker. Thinner panels shall be nailed at edges 3 inches on center and at 6 inches on center throughout remainder of panel. Nailing at edges shall be 3/8 inch from edges. A clearance of 1/4 inch shall be provided at walls. Joints of underlayment shall not be located directly over parallel joints of subflooring. Power-driven wire staples of lengths recommended by the underlayment manufacturer may be used in lieu of nails. When plywood combination subfloor-underlayment is used in lieu of separate layers, it shall be installed as specified for plywood subfloor, except all joints shall be made over supports with edge and joints spaced 1/8 inch apart. When plywood combination subfloor-underlayment is tongued and grooved, only end joints shall require support. Tongued and grooved combination subfloor-underlayment shall be applied with joints spaced 1/8 inch apart. Any surface roughness at nail heads or joints shall be lightly sanded to blend with the undisturbed surface. For floors receiving a vinyl finish flooring, a separate layer of fully-sanded underlayment shall be installed as provided for above over combination subfloor-underlayment panels.



### 3.4 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

#### 3.4.1 Bridging

Wood bridging shall have ends accurately bevel-cut to afford firm contact and shall be nailed at each end with two nails. Metal bridging shall be installed as recommended by the manufacturer. The lower ends of bridging shall be driven up tight and secured after subflooring or roof sheathing has been laid and partition framing installed.

#### 3.4.2 Corner Bracing

Corner bracing shall be installed when required by type of sheathing used or when siding, other than panel siding, is applied directly to studs. Corner bracing shall be let into the exterior surfaces of the studs at an angle of approximately 45 degrees, shall extend completely over wall plates, and shall be secured at each bearing with two nails.

#### 3.4.3 Blocking

Blocking shall be provided as necessary for application of siding, sheathing, subflooring, wallboard, and other materials or building items, and to provide firestopping. Blocking for firestopping shall ensure a maximum dimension of 8 feet for any concealed space. Blocking shall be cut to fit between framing members and rigidly nailed thereto.

#### 3.4.4 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. Stacked nailers shall be assembled with spikes or nails spaced not more than 18 inches on center and staggered. Beginning and ending nails shall not be more than 6 inches for nailer end. Ends of stacked nailers shall be offset approximately 12 inches in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to the recommendations contained in FM DS 1-49.

#### 3.4.5 Furring Strips

Furring strips shall be provided at the locations shown. Furring strips shall be installed at 16 inches on center unless otherwise shown, run in lengths as long as practicable, butt jointed and rigidly secured in place.

#### 3.4.6 Sill Plates

Sill plates shall be set level and square and anchor bolted at not more than 6 feet on centers and not more than 12 inches from end of each piece. A minimum of two anchors shall be used for each piece.



## 3.5 TABLES

TABLE I. SPECIES AND GRADE

Subflooring, Roof Sheathing, Wall Sheathing, Furring						
Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm	
NHLA Rules	Cypress			X		
NELMA Grading Rules	Northern White Cedar					X
	Eastern White Pine	X				
	Northern Pine	X				
	Balsam Fir					X
	Eastern Hemlock- Tamarack					X
RIS Grade Use	Redwood		X			
SCMA Spec	Cypress			X		
SPIB 1003	Southern Pine		X			
WCLIB 17	Douglas Fir-Larch	X				
	Hem-Fir	X				
	Sitka Spruce	X				
	Mountain Hemlock	X				
	Western Cedar	X				
WWPA G-5	Douglas Fir-Larch	X				
	Hem-Fir	X				
	Idaho White Pine	X				
	Lodgepole Pine				X	
	Ponderosa Pine				X	
	Sugar Pine				X	
	Englemann Spruce				X	
	Douglas Fir South				X	
	Mountain Hemlock				X	
	Subalpine Fir				X	
	Western Cedar				X	

TABLE II. SPECIES AND GRADE

Wood Bumpers			
Grading Rules	Species	No. 1	No. 2
NHLA Rules	Red Oak	X	
NELMA Grading Rules	Northern Pine		X
	Eastern Hemlock-		X
	Tamarack		
SPIB 1003	Southern Pine	X	
WCLIB 17	Douglas Fir-Larch		X
	Hem-Fir		X
WWPA G-5	Douglas Fir-Larch		X
	Hem-Fir		X
	Douglas Fir-South		X

-- End of Section --

## SECTION 06200A

FINISH CARPENTRY  
11/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.6 (1998) Hardboard Siding

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1435 (1999) Outdoor Weathering of Plastics

ASTM D 2898 (1994; R 1999) Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing

ASTM D 3679 (1999) Rigid Poly(Vinyl Chloride) (PVC) Siding

ASTM F 547 (1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and Wood-Based Materials

## AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C20 (1999) Structural Lumber Fire-Retardant Pressure Treatment

AWPA C27 (1999) Plywood - Fire-Retardant Pressure Treatment

AWPA C9 (1997) Plywood - Preservative Treatment by Pressure Processes

AWPA M4 (1999) Standard for the Care of Preservative-Treated Wood Products

AWPA P5 (2000) Standards for Waterborne Preservatives

## APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E445S (2001; R 2002) Performance Standards and

Policies for Structural-Use Panels (APA  
PRP-108)

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds (1999) Architectural Woodwork Quality  
Standards

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules (1997) Standard Grading Rules for  
Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS)

RIS Grade Use (1987) Grades of California Redwood Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec (1986; Supple No. 1, Aug 1993) Standard  
Specifications for Grades of Southern  
Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003 (1994; Supple 8 thru 11) Standard Grading  
Rules for Southern Pine Lumber

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1 (1996) Voluntary Product Standard -  
Construction and Industrial Plywood

PS2 (1992) Performance Standards for  
Wood-Based Structural-Use Panels

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (1996; Supples VII(A-E), VIII(A-C))  
Grading Rules for West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5 (1998) Western Lumber Grading Rules

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)

WMMPA WM 6 (1987) Industry Standard for Non-Pressure  
Treating of Wood Millwork

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;  
submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Finish Carpentry; G, AE

Drawings showing fabricated items and special mill and woodwork items. Drawings shall indicate materials and details of construction, methods of fastening, erection, and installation.

SD-03 Product Data

Wood Items, Siding, and Trim; ,

Manufacturer's printed data indicating the usage of engineered or recycled wood products, and environmentally safe preservatives.

SD-04 Samples

Siding; G, AE

Moldings; G, AE

Fascias and Trim; G, AE

Samples shall be of sufficient size to show patterns, color ranges, and types, as applicable, of the material proposed to be used.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well-ventilated areas, and protected from extreme changes in temperature and humidity.

PART 2 PRODUCTS

2.1 WOOD ITEMS, SIDING, AND TRIM

The Contractor shall furnish products which optimize design by reducing the amount of wood used (engineered wood), by using recycled wood products and preservatives without arsenic or chromium when the products and methods are competitive in price or directed by the Contracting Officer. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.1.1 Grading and Marking

Materials shall bear the grademark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks on a material shall be in accordance with the rule or standard under which the material is produced, including requirements

for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification. The inspection agency for lumber shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Except for plywood, wood structural panels, and lumber, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be architecturally exposed to view shall not bear grademarks, stamps, or other types of identifying marks.

#### 2.1.2 Sizes and Patterns

Lumber sizes and patterns shall conform to rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Sizes and patterns for materials other than lumber shall conform to requirements of the rules or standards under which produced. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

#### 2.1.3 Moisture Content

The maximum moisture content of untreated trim and wood siding shall be 15 percent at the time of delivery to the jobsite and when installed. Moisture content of all other material shall be in accordance with the standard under which the product is produced.

#### 2.1.4 Preservative Treatment

##### 2.1.4.1 Plywood

Plywood shall be treated in accordance with AWPA C9 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

- a. 0.25 pcf intended for above ground use.
- b. 0.4 pcf intended for ground contact and fresh water use.

##### 2.1.4.2 Exterior Wood Molding and Millwork

Exterior wood molding and millwork within 18 inches of soil, in contact with water or concrete shall be preservative-treated in accordance with WMMPA WM 6. Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil.

#### 2.1.5 Siding

Panel siding shall be plywood.

##### 2.1.5.1 Panel Plywood Siding

Panel plywood siding shall conform to PS1, exterior medium-density overlay, 4 feet wide, maximum practicable lengths, span rating of 16 inch on



centers, smooth face.

#### 2.1.6 Fascias and Exterior Trim

##### 2.1.6.1 Wood

Fascias and exterior trim, shall be species and grade listed in TABLE I at the end of this section. Sizes shall be as indicated.

#### 2.1.7 Interior Standing and Running Trim for Transparent Finish

Interior standing and running trim indicated to receive transparent finish shall be of AWI Custom Grade and quality suitable for transparent finish, and shall be of the following species:

Wood Railing System at Grandstand: Southern Yellow Pine or Eastern White Pine.

Wood trim at V.I.P. Suite (Room 118): White Maple.

Other wood trim indicated to receive transparent finish, except trim associated with interior board paneling at wood railing system: White Maple.

#### 2.1.8 Interior Standing and Running Trim for Opaque Finish

Interior standing and running trim indicated to receive opaque finish shall be of AWI Custom Grade and of species and grade listed in TABLE I at the end of this section.

#### 2.1.9 Interior Board Paneling

Interior board paneling at wood railing system at Grandstand shall be of AWI Custom Grade, Southern Yellow Pine, of quality suitable for transparent finish.

##### 2.1.10 Woodwork Items

##### 2.1.10.1 Shelving and Clothing Rods

Shelving shall be 3/4" medium-density fiberboard shelving with radiused front edge.

Shelf Brackets and Standards: Factory-painted formed steel with provision to support clothes rod where rod is indicated.

Clothes Rods: 1-1/2" diameter, clear, kiln-dried hardwood rod.

#### 2.2 NAILS

Nails shall be the size and type best suited for the purpose and shall conform to ASTM F 547. Nails shall be hot-dip galvanized or aluminum when used on exterior work. For siding, length of nails shall be sufficient to extend 1-1/2 inches into supports, including wood sheathing over framing.

Screws for use where nailing is impractical shall be size best suited for purpose.

### PART 3 EXECUTION

#### 3.1 GENERAL

##### 3.1.1 Installation of Siding

Siding shall be accurately fitted and positioned without springing or otherwise forcing siding in place. Siding to have a paint finish shall have nails driven flush.

##### 3.1.2 Panel Siding

Panels shall be applied with edges at joints spaced in accordance with manufacturer's recommendations. Shiplapped edges or square edges covered with battens shall be primed for paint finish, and all edges shall be backed with framing members. Panels shall be nailed at edges at 6 inches on center and at intermediate supports at 12 inches on center unless otherwise shown. Nailing at edges shall be 3/8 inch from edges.

#### 3.2 FASCIAS AND EXTERIOR TRIM

Exposed surfaces and square edges shall be machine sanded, caulked, and constructed to exclude water. Joints of built-up items, in addition to nailing, shall be glued as necessary for weather-resistant construction. End joints in built-up members shall be well distributed. Joints in flat work shall be shouldered. Backs of wide-faced miters shall be held together with metal rings and glue. Fascias and other flat members shall be in maximum practicable lengths. Cornices shall be braced, blocked, and rigidly anchored for support and protection of vertical joints.

#### 3.3 Interior Standing and Running Trim and Board Paneling

Molding, interior trim and board paneling shall be installed straight, plumb, level and with closely fitted joints. Millwork shall be installed with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Pieces shall not be less than 24 inches (610 mm) long, except where necessary. Joints shall be staggered in adjacent and related standing and running trim. Exposed surfaces shall be machine sanded at the mill. Molded work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Scarf joints shall be used at end-to-end joints. Window and door trim shall be provided in single lengths. Blind nailing shall be used to the extent practicable, and face nailing shall be set and stopped with a nonstaining putty to match the finish applied. Screws shall be used for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

## 3.4 WOODWORK ITEMS

## 3.4.1 Shelving

Shelving shall be anchored to supporting construction. Unless otherwise indicated, shelves shall be supported by wall-supported brackets not more than 24 inches on center or as required to limit deflection to 1/4 inch between supports with a load of 35 lb per lineal foot. Adjustable shelf hardware shall be steel standards, channel shaped, with 1 inch adjustment slots and brackets designed for attachment to standards.

## 3.4.2 Clothes Hanger Rods

Rods shall be provided where indicated. Rods shall be hardwood 1-1/2 inches in diameter. Rods shall be set parallel with the front edges of the shelving, and shall be supported at each end by suitable sockets, and by intermediate brackets spaced at not more than 4 foot centers.

## 3.5 TABLES

Unless specified otherwise, wood species for finished carpentry shall be as listed in table below.

TABLE I. SPECIES AND GRADE TABLES

Grading Rules	Species	Choice	Clear	C Select	C & Better
NELMA Grading Rules					
	Eastern Cedar				X
	Eastern Hemlock		X		
	Tamarack				X
	Eastern W. Pine				X
	Northern Pine				X
	Eastern Spruce			X	
	Balsam Fir		X		
RIS Grade Use	Redwood			X	
SCMA Spec	Cypress			X	
SPIB 1003	Southern Pine				X
WCLIB 17	Douglas Fir				X
	Larch				X
	Hemlock Fir				X
	Mountain Hemlock				X
	Sitka Spruce				X
WWPA G-5					
	Douglas Fir				X
	Larch				X
	Hemlock Fir		X		
	Mountain Hemlock				X
	Western Larch		X		

TABLE I. SPECIES AND GRADE TABLES

Grading Rules	Species	Choice	Clear	C Select	C & Better
	Idaho White Pine	X			
	Lodgepole Pine		X		
	Ponderosa Pine		X		
	Sugar Pine		X		
	Englemann Spruce		X		
	Douglas Fir South		X		
	Subalpine Fir		X		

NOTE 1: Western Cedar under WCLIB 17 shall be Grade B; and under WWPA G-5, Western Cedar shall be Grade B bevel for siding and Grade A for trim.

NOTE 2: Except as specified in NOTE 3 below, siding and exterior trim shall be any of the species listed above. Interior trim shall be any one of the species listed above and one grade below highest grade of species for paint finish.

NOTE 3: Southern Yellow Pine, Douglas Fir, Larch, Western Larch, and Tamarack shall not be used where painting is required and may be used on exterior work only when approved and stained with a preservative type stain.

-- End of Section --

## SECTION 06410A

ARCHITECTURAL CASEWORK  
11/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |             |  |
|-------------|--|
| ANSI A161.2 | (1998) Decorative Laminate Countertops,<br>Performance Standards for Fabricated High<br>Pressure |
| ANSI A208.1 | (1999) Particleboard Mat Formed Woods  |
| ANSI A208.2 | (1994) Medium Density Fiberboard (MDF)   |

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |             |  |
|-------------|--|
| ASTM D 1037 | (1999) Evaluating Properties of Wood-Base<br>Fiber and Particle Panel Materials                        |
| ASTM E 84   | (2000a) Surface Burning Characteristics of<br>Building Materials                                       |
| ASTM F 547  | (1977; R 1995) Definitions of Terms<br>Relating to Nails for Use with Wood and<br>Wood-Based Materials |

## ARCHITECTURAL WOODWORK INSTITUTE (AWI)

- |               |  |
|---------------|--|
| AWI Qual Stds | (1999) Architectural Woodwork Quality<br>Standards |
|---------------|--|

## BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

- |             |                         |
|-------------|-------------------------|
| BHMA A156.9 | (1994) Cabinet Hardware |
|-------------|-------------------------|

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- |             |  |
|-------------|--|
| NEMA LD 3   | (1995) High-Pressure Decorative Laminates  |
| NEMA LD 3.1 | (1995) Performance, Application,<br>Fabrication, and Installation of<br>High-Pressure Decorative Laminates |

## WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A

(1997) Architectural Wood Flush Doors

## 1.2 GENERAL DESCRIPTION

Work in this section includes wood cabinets and plastic-laminate countertops as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish shall be shop finished.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. All items designated with a "G", including product literature, calculations, component data, certificates, diagrams, drawings, and samples shall be submitted concurrently in one complete system submittal. Omission of any required submittal item from the package shall be sufficient cause for disapproval of the entire submittal. Unless otherwise indicated in the submittal review commentary, disapproval of any item within the package shall require a re-submittal of the entire system package, in which all deficiencies shall be corrected. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

## SD-02 Shop Drawings

Shop Drawings; G, AE  
Installation; G, AE

Shop drawings showing all fabricated casework items in plan view, elevations and cross-sections to accurately indicate materials used, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawing casework items shall be clearly cross-referenced to casework items located on the project drawings. Shop drawings shall include a color schedule of all casework items to include all countertop, exposed, and semi-exposed cabinet finishes to include finish material manufacturer, pattern, and color.

## SD-03 Product Data

Wood Materials; G, AE  
Wood Finishes; G, AE  
Finish Schedule; G, AE

Descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of

construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance with AWI Qual Stds for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes re-cycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

#### SD-04 Samples

Plastic Laminates; G, AE

Two samples of each plastic laminate pattern and color. Samples shall be a minimum of 5 by 7 inches in size.

Veneer-Faced Panel Products; G, AE

Two samples for each species with shop-applied transparent finish. Samples shall be 8 x 10 inches.

#### SD-07 Certificates

Quality Assurance ,  
Laminate Clad Casework ,

A quality control statement which illustrates compliance with and understanding of AWI Qual Stds requirements, in general, and the specific AWI Qual Stds requirements provided in this specification. The quality control statement shall also certify a minimum of ten years contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

### 1.4 QUALITY ASSURANCE

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the premium grade quality standards as outlined in AWI Qual Stds, Section 400G for general requirements, Section 400A for wood cabinets and Section 400C for countertops. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Contractor must demonstrate knowledge and understanding of AWI Qual Stds requirements for the quality grade indicated.

### 1.5 DELIVERY AND STORAGE

Casework may be delivered knockdown or fully assembled. All units shall be delivered to the site in undamaged condition, stored off the ground in

fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

#### 1.6 SEQUENCING AND SCHEDULING

Work shall be coordinated with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

#### 1.7 PROJECT/SITE CONDITIONS

Field measurements shall be verified as indicated in the shop drawings before fabrication.

### PART 2 PRODUCTS

#### 2.1 WOOD MATERIALS

##### 2.1.1 Lumber

All framing lumber shall be kiln-dried, graded in accordance with AWI for Grade or Work specified, to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 3/4 inch hardwood.

##### 2.1.1.1 Standing and Running Trim

Standing or running trim casework components which are specified to receive a transparent finish shall be white maple, plain sawn. AWI grade shall be premium. Location, shape, and dimensions shall be as indicated on the drawings.

##### 2.1.2 Panel Products

##### 2.1.2.1 Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood, AWI Qual Stds Grade AA. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings.

##### 2.1.2.2 Particleboard

All particleboard shall be industrial grade, medium density (40 to 50 pounds per cubic foot), 3/4 inch thick. A moisture-resistant particleboard in grade Type 2-M-2 or 2-M-3 shall be used as the substrate for plastic laminate covered countertops and other areas subjected to moisture. Particleboard shall meet the minimum standards listed in ASTM D 1037 and ANSI A208.1.

##### 2.1.2.3 Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate in accordance with AWI for Grade of Work specified. Medium density fiberboard



shall meet the minimum standards listed in ANSI A208.2.

#### 2.1.2.4 Veneer-Faced Panel Products

Wood-veneer-faced panel products.

Core: In accordance with AWI for grade of work specified for location of cabinet component.

Wood Veneer Species: White maple, plain-sliced.

Wood Veneer Grade: In accordance with AWI for grade of work specified for location of cabinet component.

Grain Direction: Vertically for drawer fronts, doors, and fixed panels.

Matching of Veneer Leaves: Book match.

Vertical Matching of Veneer Leaves: End match.

Veneer Matching within Panel Face: Balance match.

#### 2.2 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on Section 09915 COLOR SCHEDULE . Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

##### 2.2.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 0.048 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

##### 2.2.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

##### 2.2.3 Cabinet Liner Standard (CLS) Grade

Cabinet liner standard grade plastic laminate shall be 0.020 inches in thickness. This laminate grade is intended for light duty semi-exposed interior surfaces of casework components.

##### 2.2.4 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be

0.020 inches. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

## 2.3 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for all semi-exposed surfaces.

## 2.4 CABINET HARDWARE

All hardware shall conform to BHMA A156.9, unless otherwise noted, and shall consist of the following components:

- a. Door Hinges: Framless Concealed (European) type, BHMA No. B01602, 135 degrees of opening, self-closing.
- b. Cabinet Pulls: Metal wiretype, 4 inches long, 5/16 inch in diameter.
- c. Drawer Slide: Side mounted and extending under bottom edge of drawer type, BHMA No. B05091 with extension and a minimum 100 pound load capacity. Slides shall include an integral stop to avoid accidental drawer removal.
- d. Adjustable Shelf Support System:
  - 1) Recessed (mortised) metal standards, BHMA No. B04071. Support clips for the standards shall be closed type, BHMA No. B04081.

## 2.5 Hardware Finishes

For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated: Satin Stainless Steel, BHMA 630.

For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.6 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F 547 where applicable.

## 2.7 ADHESIVES, CAULKS, AND SEALANTS

### 2.7.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing.

#### 2.7.1.1 Wood Joinery

Adhesives used to bond wood members shall be resorcinol. polyvinyl acetate resin emulsion . Adhesives shall withstand a bond test as described in WDMA I.S. 1-A.

#### 2.7.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be a water-based contact adhesive or adhesive consistent with AWI and laminate manufacturer's recommendations.

#### 2.7.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

#### 2.7.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

### 2.8 WOOD FINISHES

Paint, stain, varnish and their applications required for laminate clad casework components shall be AWI TR-4, waterborne conversion varnish finish.

### 2.9 FABRICATION

Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. All openings and dimensions at casework installation locations shall be field verified before fabrication of casework. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI premium grade unless otherwise indicated in this specification. Cabinet style, in accordance with AWI Qual Stds, Section 400-A descriptions, shall be flush overlay .

#### 2.9.1 Base and Wall Cabinet Case Body

Frame members shall be glued-together, kiln-dried hardwood lumber. Top corners, bottom corners, and cabinet bottoms shall be braced with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Cabinet components shall be constructed from the following materials and thicknesses:

a. Body Members (Ends, Divisions, Bottoms, and Tops): 3/4 inch particleboard or medium density fiberboard 9MDF) panel product.

c. Shelving: 3/4 inch particleboard or medium density fiberboard 9MDF panel product.

d. Cabinet Backs: 1/4 inch particleboard or medium density fiberboard 9MDF panel product.

e. Drawer Sides, Backs, and Subfronts: 1/2 inch hardwood lumber or panel product.

f. Drawer Bottoms: 1/4 inch particleboard, medium density fiberboard 9MDF) or veneer core plywood panel product.

g. Door and Drawer Fronts: 3/4-inch particleboard or medium density fiberboard 9MDF panel product.

#### 2.9.1.1 Joinery Method for Case Body Members

##### a. Tops, Exposed Ends, and Bottoms.

1) Steel "European" assembly screws (1-1/2 inch from end, 5 inch on center, fasteners will not be visible on exposed parts).

2) Doweled, glued under pressure (approx. 4 dowels per 12 inches of joint).

3) Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).

##### b. Exposed End Corner and Face Frame Attachment.

1) For mitered joint: lock miter or spline or biscuit, glued under pressure (no visible fasteners).

2) For non-mitered joint (90 degree): butt joint glued under pressure (no visible fasteners).

c. Cabinet Backs (Wall Hung Cabinets): Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Fabrication method shall be:

1) Full bound, captured in grooves on cabinet sides, top, and bottom. Cabinet backs for floor standing cabinets shall be side bound, captured in grooves; glued and fastened to top and bottom.

2) Full overlay, plant-on backs with minimum back thickness of 1/2 inch and minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

##### d. Cabinet Backs (Floor Standing Cabinets).

1) Side bound, captured in grooves; glued and fastened to top and

bottom.

2) Full overlay, plant-on backs with minimum back thickness of 1/2 inch and minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

e. Wall Anchor Strips shall be required for all cabinets with backs less than 1/2 inch thick. Strips shall consist of minimum 1/2 inch thick lumber, minimum 2-1/2 inches width; securely attached to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

#### 2.9.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of 3/4 inch fiberboard. Base assembly components shall be a moisture-resistant panel product. Finished height for each cabinet base shall be as indicated on the drawings. Bottom edge of the cabinet door or drawer face shall be flush with top of base.

#### 2.9.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from 3/4 inch medium density particleboard or 3/4 inch medium density fiberboard (MDF). All door and drawer front edges shall be edgebanded with solid wood edgeband, same species as face, minimum thickness 0.20 inch.

#### 2.9.4 Drawer Assembly

Drawer components shall consist of a removable drawer front, sides, backs, and bottom. Drawer components shall be constructed of the following materials and thicknesses:

b. Drawer Sides and Backs For Laminate Finish: 1/2 inch thick 7-ply hardwood veneer core substrate.

c. Drawer Sides and Back For Thermoset Decorative Overlay (melamine) Finish: 1/2 inch thick medium density particleboard or MDF fiberboard substrate.

d. Drawer Bottom: 1/4 inch thick veneer core panel product for plastic laminate finish or thermoset decorative overlay melamine panel product.

##### 2.9.4.1 Drawer Assembly Joinery Method

a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure.

b. Doweled, glued under pressure.

c. Lock shoulder, glued and pin nailed.

d. Bottoms shall be set into sides, front, and back, 1/4 inch deep groove with a minimum 3/8 inch standing shoulder.

#### 2.9.5 Shelving

Shelving shall be fabricated from 3/4 inch medium density particleboard 3/4 inch of medium density fiberboard (MDF). All shelving top and bottom surfaces shall be finished with HPDL plastic laminate. Shelf edges shall be finished in a HPDL plastic laminate.

##### 2.9.5.1 Shelf Support System

The shelf support system shall be:

a. Recessed (mortised) metal shelf standards. Standards shall be mortised flush with the finishes surface of the cabinet interior side walls, two per side. Standards shall be positioned and spaced on the side walls to provide a stable shelf surface that eliminates tipping when shelf front is weighted. Standards shall be installed and adjusted vertically to provide a level, stable shelf surface when clips are in place.

#### 2.9.6 Laminate Clad Countertops

Laminate countertop substrate shall be constructed of 3/4 inch particleboard or medium density fiberboard (MDF). The substrate shall be moisture-resistant where countertops receive sinks, lavatories, or are subjected to liquids. All substrates shall have sink cutout edges sealed with appropriate sealant against moisture. No joints shall occur at any cutouts. A balanced backer sheet is required.

##### 2.9.6.1 Edge Style

Front and exposed side countertop edges shall be in shapes and to dimensions as shown on the drawings. The countertop edge material shall be:

d. Plastic laminate Self Edge. Flat, 90 degree "self" edge. Edge must be applied before top. Laminate edge shall overlap countertop laminate and shall be eased to eliminate sharp corners.

#### 2.9.7 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and NEMA LD 3.1, using tools and devices specifically designed for laminate fabrication and application.

Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to NEMA LD 3.1 and ANSI A161.2. Laminate types

and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

a. Base/Wall Cabinet Case Body.

- 2) Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: HPDL Grade CLS .

b. Adjustable Shelving.

- 1) Top and bottom surfaces: HPDL Grade HGS .
- 2) All edges: HPDL Grade VGS .

c. Fixed Shelving.

- 1) Top and bottom surfaces: HPDL Grade HGS .
- 2) Exposed edges: HPDL Grade VGS .

d. Door, Drawer Fronts, Access Panels.

- 1) Interior (semi-exposed) faces: HPDL Grade VGS
- 2) Edges: HPDL Grade VGS .

e. Drawer Assembly.

All interior surfaces: HPDL Grade CLS .

f. Countertops and Splashes.

- 1) All exposed and semi-exposed surfaces: HPDL Grade HGS

2.9.7.1 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI Qual Stds premium grade requirements.

2.9.8 Finishing

2.9.8.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

2.9.8.2 Sanding

All surfaces requiring coatings shall be prepared by sanding with a grit and in a manner that scratches will not show in the final system.

### 2.9.8.3 Coatings

Types, method of application and location of casework finishes shall be in accordance with the finish schedule, drawings and Section 09900 PAINTING, GENERAL. All cabinet reveals shall be painted.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI Qual Stds premium quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

#### 3.1.1 Anchoring Systems

##### 3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Cabinet assemblies shall be attached to anchored bases without visible fasteners. Where assembly abutts a wall surface, anchoring shall include a minimum 1/2 inch thick lumber or panel product hanging strip, minimum 2-1/2 inch width; securely attached to the top of the wall side of the cabinet back.

##### 3.1.1.2 Wall

Cabinet to be wall mounted shall utilize minimum 1/2 inch thick lumber or panel product hanging strips, minimum 2-1/2 inch width; securely attached to the wall side of the cabinet back, both top and bottom.

#### 3.1.2 Countertops

Countertops shall be installed in locations as indicated on the drawings. Countertops shall be fastened to supporting casework structure with mechanical fasteners, hidden from view. All joints formed by the countertop or countertop splash and adjacent wall surfaces shall be filled with a clear silicone caulk.

#### 3.1.3 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, the use of plastic or synthetic insertion dowels shall be used to receive 3/16 inch "Euroscrews". The use of wood screws without insertion dowels is prohibited.

#### 3.1.4 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished



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within target fitting tolerances for gaps and flushness in accordance with AWI Qual Stds premium grade requirements.

#### 3.1.5 Plumbing Fixtures

Sinks, sink hardware, and other plumbing fixtures shall be installed in locations as indicated on the drawings and in accordance with Section 15400 PLUMBING, GENERAL PURPOSE .

-- End of Section --

## SECTION 06650

SOLID POLYMER (SOLID SURFACING) FABRICATIONS  
10/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |             |  |
|-------------|--|
| ANSI A108.1 | (1999) Installation of Ceramic Tile;<br>including A108.1A-C, 108.4-.13, 118.1-.10,<br>A136.1 |
| ANSI Z124.3 | (1995) Plastic Lavatories  |
| ANSI Z124.6 | (1997) Plastic Sinks   |

## ASTM INTERNATIONAL (ASTM)

- |             |  |
|-------------|--|
| ASTM D 570  | (1998) Water Absorption of Plastics  |
| ASTM D 638  | (2002) Tensile Properties of Plastics  |
| ASTM D 696  | (1998) Coefficient of Linear Thermal<br>Expansion of Plastics Between Minus 30<br>degrees C and 30 degrees C With a Vitreous<br>Silica Dilatometer |
| ASTM D 2583 | (1995; R 2001e1) Indentation Hardness of<br>Rigid Plastics by Means of a Barcol<br>Impressor   |
| ASTM E 84   | (2001) Surface Burning Characteristics of<br>Building Materials  |
| ASTM G 21   | (1996; R 2002) Determining Resistance of<br>Synthetic Polymeric Materials to Fungi   |

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- |           |   |
|-----------|---|
| NEMA LD 3 | (1995) High Pressure Decorative Laminates |
|-----------|---|

## 1.2 GENERAL DESCRIPTION

Work in this section includes countertops and other items utilizing solid polymer (solid surfacing) fabrication as shown on the drawings and as

described in this specification.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Shop Drawings; G, AE

Shop Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work.

#### SD-03 Product Data

Solid polymer material  
Qualifications  
Fabrications

Product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive, sealants, and heat reflective tape. Both the manufacturer of materials and the fabricator shall submit a detailed description of operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

#### SD-04 Samples

Material; G, AE

A minimum 4 by 4 inch sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work.

#### SD-06 Test Reports

Solid polymer material

Test report results from an independent testing laboratory attesting that the submitted solid polymer material meets or exceeds each of the specified performance requirements.

#### SD-07 Certificates

Fabrications  
Qualifications

Solid polymer manufacturer's certification attesting to fabricator qualification approval.

SD-10 Operation and Maintenance Data

Clean-up

A minimum of six copies of maintenance data indicating manufacturer's care, repair and cleaning instructions. Maintenance video shall be provided, if available. Maintenance kit for matte finishes shall be submitted.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall not be delivered to project site until areas are ready for installation. Materials shall be stored indoors and adequate precautions taken to prevent damage to finished surfaces. Protective coverings shall be provided to prevent physical damage or staining following installation, for duration of project.

1.5 WARRANTY

Manufacturer's warranty of ten years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat, shall be provided. Warranty shall provide for material and labor for replacement or repair of defective material for a period of ten years after component installation.

1.6 QUALIFICATIONS

To insure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. All fabrications shall be marked with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials.

PART 2 PRODUCTS

2.1 MATERIAL

Solid polymer material shall be a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting ANSI Z124.3 and ANSI Z124.6 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.01 inch shall be repairable by sanding or polishing. Material thickness shall be as indicated on the drawings. In no case shall material be less than 1/4 inch in thickness.

## 2.1.1 Cast, 100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material shall be composed of acrylic polymer, mineral fillers, and pigments and shall meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	5800 psi (min.)	ASTM D 638
Hardness	55-Barcol Impressor (min.)	ASTM D 2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D 696
Boiling water Surface Resistance	No Change	NEMA LD 3-3.05
High Temperature Resistance	No Change	NEMA LD 3-3.06
Impact Resistance (Ball drop)		NEMA LD 3-303
1/4" sheet	36", 1/2 lb ball, no failure	
1/2" sheet	140", 1/2 lb ball, no failure	
3/4" sheet	200", 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G 21
Bacteria Growth	No Growth	ASTM G 21
Liquid Absorption (Weight in 24 hrs.)	0.1% max.	ASTM D 570
Flammability		ASTM E 84
Flame Spread	25 max.	
Smoke Developed	30 max	

## 2.1.2 Material Patterns and Colors

Patterns and colors for all solid polymer components and fabrications shall be those indicated on the project color schedule. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth

(thickness) of the solid polymer material.

#### 2.1.3 Surface Finish

Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be matte; gloss rating of 5-20 .

### 2.2 ACCESSORY PRODUCTS

Accessory products, as specified below, shall be manufactured by the solid polymer manufacturer or shall be products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.

#### 2.2.1 Seam Adhesive

Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.

#### 2.2.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting ANSI A108.1, Underwriter's Laboratories (UL) listed. This adhesive shall be used to bond solid polymer components to adjacent and underlying substrates.

#### 2.2.3 Silicone Sealant

Sealant shall be a mildew-resistant, FDA and UL listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid polymer manufacturer. Sealant shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.

### 2.3 FABRICATIONS

Components shall be factory or shop fabricated to the greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and manufacturer's requirements. All dimensions at solid surfacing element installation locations shall be field verified before beginning fabrication. Factory cutouts shall be provided for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected.

#### 2.3.1 Joints and Seams

Joints and seams shall be formed between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in

appearance and without voids to create a monolithic appearance.

#### 2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish.

Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

#### 2.3.3 Counter and Vanity Top Splashes

Backsplashes and end splashes shall be fabricated from 1/2 inch thick solid surfacing material and shall be provided to dimensions and shapes as indicated on the drawings. Backsplashes and end splashes shall be provided at locations indicated on the drawings. Backsplashes shall be shop fabricated and be permanently attached .

##### 2.3.3.1 Permanently Attached Backsplash

Permanently attached backsplashes shall be attached straight with seam adhesive to form a 90 degree transition .

##### 2.3.3.2 End Splashes

End splashes shall be provided loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

#### 2.3.4 Counter and Vanity Tops

All solid surfacing, solid polymer counter top and vanity top components shall be fabricated from 1/2 inch thick material. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Counter tops shall be complete with permanently attached, 90 degree transition where indicated on the drawings, of height indicated on drawings. Attach 2 inch wide reinforcing strip of polymer material under each horizontal counter top seam.

##### 2.3.4.1 Counter Top With Sink

###### A. Stainless Steel or Vitreous China Sink.

Countertops with sinks shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for stainless steel installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

##### 2.3.4.2 Vanity Tops With Bowls

###### A. Vitreous China Bowl

Countertops with vitreous china bowls shall include cutouts to template

as furnished by the sink manufacturer. Manufacturer's standard sink mounting hardware for vitreous china undermount installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

### PART 3 EXECUTION

#### 3.1 COORDINATION

In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to insure that necessary structural wall support, cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of wall panels, countertops, shelving, and all other solid polymer fabrications to the degree and extent recommended by the solid polymer manufacturer. Contractor shall appropriate staging areas for solid polymer fabrications.

#### 3.2 INSTALLATION

##### 3.2.1 Components

All components and fabricated units shall be installed plumb, level, and rigid. Field joints between solid polymer components to provide a monolithic appearance shall be made using solid polymer manufacturer's approved seam adhesives, with joints inconspicuous in the finished work. Metal or vitreous china sinks and lavatory bowls shall be attached to counter tops using solid polymer manufacturer's recommended clear silicone sealant and mounting hardware. Solid polymer sinks and bowls shall be installed using a color-matched seam adhesive. Plumbing connections to sinks and lavatories shall be made in accordance with Section 15400A PLUMBING, GENERAL PURPOSE .

##### 3.2.2 Silicone Sealant

A clear, silicone sealant or caulk shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Sealant bead shall be smooth and uniform in appearance and shall be the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Bead shall be continuous and run the entire length of the joint being sealed.

##### 3.2.3 Plumbing

Plumbing connections to sinks and lavatories shall be made in accordance with Section 15400A .



### 3.3 CLEAN-UP

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items. Components damaged after installation by other trades will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made. The Contractor shall submit maintenance data as specified in the Submittals paragraph, under SD-10.

-- End of Section --

SECTION 07110A

BITUMINOUS DAMPPROOFING  
02/04

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D 1227	(1995; R 2000) Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM D 41	(1994; R 2000e1) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4479	(2000) Asphalt Roof Coatings - Asbestos Free

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Materials

Certificates attesting that the materials meet the requirements specified.

1.3 QUALIFICATIONS

Work shall be performed by skilled laborers thoroughly experienced in the type of bituminous dampproofing work specified to meet the requirements of the contract.

1.4 DELIVERY, STORAGE AND HANDLING

Dampproofing materials shall be delivered to the project site in the

original sealed containers bearing the name of manufacturer, contents and brand name, and stored in a weathertight enclosure to prevent moisture damage and absorption. Dampproofing materials shall be protected from freezing. Asphalt shall be stored off the ground on pallets, and covered on top and all sides with breathable-type canvas tarpaulins. Plastic sheets cause condensation buildup; and therefore, shall not be used to cover dampproofing materials. Care shall be taken during storage to avoid separation or settlement of the emulsion components. Damaged or deteriorated materials shall be removed from the project site.

## PART 2 PRODUCTS

### 2.1 EMULSION-BASED ASPHALT DAMPPROOFING

#### 2.1.1 Fibrated Emulsion-Based Asphalt

Fibrated emulsion-based asphalt dampproofing shall be cold-applied type conforming to ASTM D 1227 Type IV, asbestos-free, manufactured of refined asphalt, emulsifiers and selected clay, fibrated with mineral fibers. For spray or brush application, emulsion shall contain a minimum of 59 percent solids by weight, 56 percent solids by volume. For trowel application, emulsion shall contain a minimum of 58 percent solids by weight, 55 percent solids by volume.

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Surfaces scheduled for bituminous dampproofing shall be prepared in accordance with dampproofing manufacturer's recommendations. Surface preparation shall be approved prior to dampproofing application.

#### 3.1.1 Protection of Surrounding Areas

Before starting the dampproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of asphalt onto other work. Drains and conductors shall be protected from clogging with asphalt.

#### 3.1.2 Masonry Surfaces

Surfaces shall be free of oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Mortar joints shall be flush and free of extraneous mortar and chipped or broken masonry.

#### 3.1.3 Concrete Surfaces

Surfaces shall be properly cured, free of form release agents, oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Form ties shall be cut flush with surface. Sharp protrusions and form match lines shall be removed. Holes, voids, spalled areas and cracks which can damage the dampproofing materials and impair performance shall be repaired.

Rough surfaces shall be parged with a well-adhering coat of cement mortar.

#### 3.1.4 Metal Surfaces

Metal surfaces shall be dry and be free of rust, scale, loose paint, oil, grease, dirt, frost and debris.

### 3.2 APPLICATION OF BITUMINOUS DAMPPROOFING

#### 3.2.1 Emulsion-Based Asphalt

Emulsion-based asphalt dampproofing work shall not be performed in temperatures below 40 degrees F. Emulsions shall have a smooth and uniform consistency at time of application. Dampproofing materials shall be applied in accordance with manufacturer's published instructions to produce a smooth uniform dry film of not less than 12 mils thick without voids or defects. Dull or porous spots shall be recoated. Dampproofing materials shall seal tightly around pipes and other items projecting through dampproofing. Rates of application shall be as follows:

- a. Primer: 1/2 gallon per 100 square feet, cold-applied.
- b. Fibrated Dampproofing: 2 gallons per 100 square feet, cold-applied with spray, brush or trowel.
- c. Non-fibrated Dampproofing: 2 gallons per 100 square feet, cold-applied with spray, brush or trowel.

### 3.3 CLEAN-UP

Surfaces of other work which are stained with dampproofing materials shall be cleaned with a cleaner recommended by dampproofing manufacturer.

### 3.4 PROTECTION

The completed dampproofing work shall be protected from damage during and after construction.

-- End of Section --

## SECTION 07212N

MINERAL FIBER BLANKET INSULATION  
09/99

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 930	(1992) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D 828	(1997) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM D 3833/D 3833M	(1996) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 84	(1998) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 136	(1996; Rev. A) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(1997) Installation of Oil Burning Equipment
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NFPA 54	(1996) National Fuel Gas Code
NFPA 70	(1999) National Electrical Code
NFPA 211	(1996) Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM	(1988) Puncture Test for Containerboard
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1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

- Blanket insulation
- Sill sealer insulation
- Vapor retarder
- Pressure sensitive tape
- Accessories

SD-08 Manufacturer's Instructions

- Insulation

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

#### 1.4 SAFETY PRECAUTIONS

##### 1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

##### 1.4.2 Smoking

Do not smoke during installation of blanket thermal insulation.

##### 1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C 930.

### PART 2 PRODUCTS

#### 2.1 BLANKET INSULATION

ASTM C 665, Type I, blankets without membrane coverings and III, blankets with reflective coverings; Class A, membrane-faced surface with a flame spread of 25 or less , except a flame spread rating of 25 or less 50 when tested in accordance with ASTM E 84.

##### 2.1.1 Thermal Resistance Value (R-VALUE)

For insulation installations at exterior walls, provide an R value of R-13.

##### 2.1.2 Recycled Materials

Provide Thermal Insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section. The minimum required recycled materials content by weight are:

Rock Wool: 75 percent slag  
Fiberglass: 20 to 25 percent glass cullet

##### 2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

#### 2.2 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C 665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E 136 for blocking around chimneys and heat producing devices.

## 2.3 ACCESSORIES

### 2.3.1 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

### 2.3.2 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

## PART 3 EXECUTION

### 3.1 EXISTING CONDITIONS

Before installing insulation, ensure that areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify Contracting Officer of such conditions.

### 3.2 PREPARATION

#### 3.2.1 Blocking at Attic Vents and Access Doors

Prior to installation of insulation, install permanent blocking to prevent insulation from slipping over, clogging, or restricting air flow through soffit vents at eaves. Install permanent blocking to maintain accessibility to equipment or controls that require maintenance or adjustment.

#### 3.2.2 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

- a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.
- b. Masonry chimneys or masonry enclosing a flue: 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.
- c. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.
- f. Gas Fired Appliances: Clearances as required in NFPA 54.



### 3.3 INSTALLATION

#### 3.3.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

##### 3.3.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

##### 3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

##### 3.3.1.3 Cold Climate Requirement

Place insulation to the outside of pipes.

##### 3.3.1.4 Insulation Blanket with Affixed Vapor Retarder

Locate vapor retarder as indicated. Do not install blankets with affixed vapor retarders unless so specified. Unless the insulation manufacturer's instructions specifically recommend not to staple the flanges of the vapor retarder facing, staple flanges of vapor retarder at 6 inch intervals flush with face or set in the side of truss, joist, or stud. Avoid gaps and bulges in insulation and "fishmouth" in vapor retarders. Overlap both flanges when using face method. Seal joints and edges of vapor retarder with pressure sensitive tape. Stuff pieces of insulation into small cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers. Cover these insulated cracks with vapor retarder material and tape all joints with pressure sensitive tape to provide air and vapor tightness.

##### 3.3.1.5 Insulation without Affixed Vapor Retarder

Provide snug friction fit to hold insulation in place. Stuff pieces of insulation into cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers.

##### 3.3.1.6 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

3.3.1.7 Access Panels and Doors

Affix blanket insulation to access panels greater than one square foot and access doors in insulated floors and ceilings. Use insulation with same R-Value as that for floor or ceiling.

-- End of Section --

## SECTION 07311

ASPHALT SHINGLES  
02/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 224	(1989; R 1996) Smooth-Surfaced Asphalt Roll Roofing (Organic Felt)
ASTM D 226	(1997; Rev. A) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 249	(1989; R 1996) Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules
ASTM D 1970	(2001) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 3018	(2000) Class A Asphalt Shingles Surfaced with Mineral Granules
ASTM D 3462	(2001) Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules
ASTM D 4586	(2000) Asphalt Roof Cement, Asbestos Free
ASTM D 4869	(1988; R 1993) Asphalt-Saturated Organic Felt Shingle Underlayment Used in Roofing

## NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA Shingle Manual	1996 Asphalt Shingle Roofing Manual
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## UNDERWRITERS LABORATORIES (UL)

UL 790	(1997) Fire Resistance of Roof Covering Materials
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UL 997 (1995) Wind Resistance of Prepared Roof  
Covering Materials

## 1.2 DEFINITIONS

### 1.2.1 Top Lap

That portion of shingle overlapping shingle in course below.

### 1.2.2 Head Lap

The triple coverage portion of top lap which is the shortest distance from the butt edge of an overlapping shingle to the upper edge of a shingle in the second course below.

### 1.2.3 Exposure

That portion of a shingle exposed to the weather after installation.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-03 Product Data

#### Shingles

Submit data including type, weight, class, UL labels, and special types of underlayment and eave flashing.

### SD-04 Samples

#### Shingles; G, AE

Full shingle sample and manufacturer's standard size samples of materials and products requiring color or finish selection.

#### Color charts; G, AE

### SD-08 Manufacturer's Instructions

#### Application

## 1.4 DELIVERY AND STORAGE

Deliver materials in the manufacturer's unopened bundles and containers bearing the manufacturer's brand name. Keep materials dry, completely covered, and protected from the weather. Store according to manufacturer's

written instructions. Roll goods shall be stored on end in an upright position or in accordance with manufacturer's recommendations. Immediately before laying, roofing felt shall be stored for 24 hours in an area maintained at a temperature not lower than 50 degrees F.

#### 1.5 WARRANTIES

Warranties shall begin on the date of Government acceptance of the work.

##### 1.5.1 Manufacturer's Warranty

Furnish the asphalt shingle manufacturer's standard 25 year warranty for the asphalt shingles. The warranty shall run directly to the Government.

##### 1.5.2 Contractor's Warranty

The Contractor shall warrant for 5 years that the asphalt shingle roofing system, as installed, is free from defects in workmanship. When repairs due to defective workmanship are required during the Contractor's warranty period, the Contractor shall make such repairs within 72 hours of notification. When repairs are not performed within the specified time, emergency repairs performed by others will not void the warranty.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

##### 2.1.1 Shingles

Mineral granule-surfaced asphalt shingles, self-sealing, square tab, strip . , architectural shingles weighing not less than 290 pounds per 100 square feet. Shingles shall meet the fire resistance requirements of UL 790 for Class A and the wind resistance requirements of UL 997. Color shall be as selected from the manufacturer's standard color charts.

##### 2.1.2 Mineral-Surfaced Asphalt Roll Roofing

ASTM D 249.

##### 2.1.3 Smooth-Surfaced Asphalt Roll Roofing

ASTM D 224, Type II.

##### 2.1.4 Underlayment

Asphalt-saturated felt conforming to ASTM D 4869 or ASTM D 226, without perforations or other material specified by the shingle manufacturer for use as underlayment.

##### 2.1.4.1 Leak Barrier Underlayment

Self-adhering leak barrier or ice dam underlayment shall comply with ASTM D 1970 for sealability around nails.

#### 2.1.5 Self-Adhering Membrane

Self-adhering rubberized asphaltic membrane, a minimum of 40 mils thick, and recommended by the shingle manufacturer for use as eaves flashing.

#### 2.1.6 Nails for Applying Shingles and Asphalt-Saturated Felt

Aluminum or hot-dipped galvanized steel or equivalent corrosion resistant with sharp points and flat heads 3/8 to 7/16 inch in diameter. Shank diameter of nails shall be a minimum of 0.105 inch and a maximum of 0.135 inch with garb or otherwise deformed for added pull-out resistance. Nails shall be long enough to penetrate completely through or extend a minimum of 3/4 inch into roof deck, whichever is less, when driven through materials to be fastened.

#### 2.1.7 Asphalt Roof Cement

ASTM D 4586, Type II.

#### 2.1.8 Asphalt Primer

ASTM D 41.

### PART 3 EXECUTION

#### 3.1 VERIFICATION OF CONDITIONS

Ensure that roof deck is smooth, clean, dry, and without loose knots. Roof surfaces shall be firm and free from loose boards, large cracks, and projecting ends that might damage the roofing. Vents and other projections through roofs shall be properly flashed and secured in position, and projecting nails shall be driven flush with the deck.

#### 3.2 SURFACE PREPARATION

Cover knotholes and cracks with sheet metal nailed securely to sheathing. Flash and secure vents and other roof projections, and drive projecting nails firmly home.

#### 3.3 APPLICATION

Apply roofing materials as specified herein unless specified or recommended otherwise by shingle manufacturer's written instructions or by NRCA Shingle Manual.

##### 3.3.1 Underlayment

Provide for roof slopes between 2 inches per foot and 4 inches per foot. Apply two layers to roof deck. Provide a 19 inch wide strip as starter sheet to maintain specified number of layers throughout roof. Lay parallel to eaves, starting at eaves. Provide minimum 19 inch head laps, 6 inch laps from both sides over hips and ridges, and 12 inch end laps in the field of the roof. Nail sufficiently to hold until shingles are applied.

Turn up vertical surfaces a minimum of 4 inches. When a self-adhering membrane is used for eave flashing, start underlayment from upper edge of eave flashing.

### 3.3.2 Drip Edges

Provide metal drip edges as specified in Section 07600, "Flashing and Sheet Metal," applied directly on the wood deck at eaves and over the underlayment at rakes. Extend back from edge of deck a minimum of 3 inches, and secure with nails spaced a maximum of 10 inches o.c. along inner edge.

### 3.3.3 Starter Strip

Apply starter strip at eaves, using 9 inch wide strip of mineral-surfaced roll roofing of a color to match shingles. Optionally, use a row of shingles with tabs removed and trimmed to ensure that joints are not exposed at shingle cutouts. Apply starter strip along eaves, overlaying and finishing even with lower edge of eave flashing strip ; fasten in a line parallel to and 3 to 4 inches above eave edge. Place nails so top of nail is not exposed in cutouts of first course of shingles. When roll roofing is provided, seal tabs of first course of shingles with asphalt roof cement. Fasten with 6 nails per strip of shingles or space nails at 6 inches o.c. for roll roofing. Seal tabs of first course of shingles with asphalt roof cement as specified below.

### 3.3.4 Shingle Courses

Start first course with full shingle, and apply succeeding courses with joints staggered at thirds or halves. Butt-end joints of shingles shall not align vertically more often than every fourth course. Apply shingle courses as follows:

- a. Fastening: Do not drive fasteners into or above the factory-applied adhesive unless adhesive is located 5/8 inch or closer to top of cutouts. Place fasteners so they are concealed by shingle top lap and penetrate the head lap.
- b. Shingles applied with nails: Nominal 5 inch exposure. Apply each shingle with minimum of four nails. Place one nail one inch from each end, and evenly space nails on a horizontal line a minimum of 5/8 inch above top of cutouts.
- c. Nailing: Apply shingles with nominal 5 inch exposure. Apply each shingle with minimum of six nails. Place one nail one inch from each end and one nail on each side of each cutout, on a horizontal line 5/8 inch above cutouts.
- d. Sealing: Seal each tab with continuous, 9 inchlong, 1/4 inch diameter bead of asphalt roof cement, applied to the surface of course below. Place bead on horizontal line 5/8 inch above cutouts so bead will be one inch from bottom edge of tab to be sealed and so bead will not show through cutouts. After nailing each shingle, press tabs down to ensure spreading and bonding of asphalt roof cement.

### 3.3.5 Hips and Ridges

Form with 9 by 12 inch individual shingles or with 12 by 12 inch shingles cut from 12 by 36 inch strip shingles. Bend shingles lengthwise down center with equal exposure on each side of hip or ridge. Lap shingles to provide a maximum 5 inch exposure, and nail each side in unexposed area 5 1/2 inches from butt and one inch in from edge.

### 3.3.6 Flashing

#### 3.3.6.1 Eave Flashing

Provide for roof slopes between 2 inches per foot and 4 inches per foot . Provide either of the following types of eave flashing:

- a. From the eaves to a point 24 inches inside interior wall line, apply solid coating of asphalt roof cement between overlapping layers of underlayment. Spread cement to a uniform thickness at rate of 2 gallons per 100 square feet of cemented roof area.
- b. From the eaves to a point 24 inches inside interior wall line, apply one layer of self-adhering membrane. Follow membrane manufacturer's printed installation instructions.

#### 3.3.6.2 Vent and Stack Flashing

Apply shingles up to point where vent or stack pipe projects through roof, and cut nearest shingle to fit around pipe. Before applying shingles beyond pipe, prepare flange of metal pipe vent flashing as specified in Section 07600, "Flashing and Sheet Metal," by applying a 1/8 inch thick coating of asphalt roof cement on bottom side of flashing flange. Slip flashing collar and flange over pipe, and set coated flange in 1/16 inch coating of asphalt roof cement. After applying flashing flange, continue shingling up roof. Lap lower part of flange over shingles. Overlap flange with side and upper shingles. Fit shingles around pipe, and embed in 1/16 inch thick coating of asphalt roof cement where shingles overlay flange.

-- End of Section --



## SECTION 07551A

MODIFIED BITUMEN ROOFING  
01/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1153	(1997) Location of Wet Insulation in Roofing Systems Using Infrared Imaging
ASTM C 208	(1995) Cellulosic Fiber Insulating Board
ASTM D 1863	(1993; R 1996) Mineral Aggregate Used on Built-Up Roofs
ASTM D 2824	(1994) Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered without Asbestos
ASTM D 312	(2000) Asphalt Used in Roofing
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4586	(1993; R 1999) Asphalt Roof Cement, Asbestos Free
ASTM D 4601	(1998) Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 4897	(1998) Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM D 517	(1998) Asphalt Plank
ASTM D 6162	(2000) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D 6163	(2000) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements

ASTM D 6164	(2000) Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
ASTM D 6222	(2000) Atactic Polypropylene (ARP) Modified Bituminous Sheet Materials Using Polyester Reinforcements
ASTM D 6223	(2000) Atactic Polypropylene (ARP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825c	(1998) Approval Guide Building Materials
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## UNDERWRITERS LABORATORIES (UL)

UL 1256	(1998) Fire Test of Roof Deck Constructions
UL 790	(1997; Rev thru Jul 1998) Tests for Fire Resistance of Roof Covering Materials
UL Bld Mat Dir	(1999) Building Materials Directory

## 1.2 SYSTEM DESCRIPTION

The modified bitumen roofing system shall consist of a manufacturer's standard, prefabricated, reinforced polymer-modified bitumen membrane, with base sheet, and insulation as specified and indicated. The manufacturer shall have a minimum of 5 years experience in manufacturing of the proposed modified bitumen sheet roofing for similar applications.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

## EVT and Flash Point

Bills of lading shall indicate the flash point and equiviscous temperature (EVT) and this information shall be shown on labels for each unit (or plug) of asphalt.

Materials; G, AE  
Installation; G, AE

Manufacturer's instructions, including membrane description and

performance data, detailed procedure for installation, and safety precautions, prior to the start of roofing work.

#### SD-07 Certificates

##### Manufacturer

Evidence that the manufacturer has a minimum of 5 years experience manufacturing modified bitumen roofing. The roofing system applicator shall be approved by the modified bitumen roofing manufacturer, and shall have a minimum of 3 years experience as an approved applicator. A list of installations using the same products and applicator as proposed shall be included.

##### Materials

Certificates of compliance for felts, bitumens, and membrane sheet.

#### 1.4 STORAGE OF MATERIALS

Felts and roofing sheets shall be kept dry before, during, and after delivery to the site. Felts and roofing sheets shall be stored on end one level high, in an enclosed building or trailer and on platforms, off the deck or floor. Felts and sheets shall be maintained at a temperature above 50 degrees F for 24 hours immediately before laying.

#### 1.5 COORDINATION REQUIREMENTS

The work shall be coordinated with other trades to ensure that components are available when they are to be secured or stripped into the roofing system.

##### 1.5.1 Insulation Application

Application of roofing shall immediately follow application of insulation as a continuous operation.

##### 1.5.2 Flashing

Modified bituminous sheet shall be used for flashings where the roof deck abuts angles, vertical surfaces, edge metal, and penetrations, unless otherwise specified or indicated. Flashing shall be installed as the work progresses.

##### 1.5.3 Sheet Metalwork

Sheet metalwork specified in Section 07600A SHEET METALWORK, GENERAL shall be coordinated with roofing operations.

#### 1.6 ENVIRONMENTAL CONDITIONS

Air temperature shall be above 40 degrees F and there shall be no visible

ice, frost, or moisture on the roof deck at the time roofing is installed.

#### 1.7 ELECTRIC-HEATED EQUIPMENT

Adequate electrical service shall be provided as required by the manufacturer of the equipment, to insure proper application of the roofing materials.

#### 1.8 WARRANTY

Manufacturer's standard warranty for the roofing system shall be provided for not less than 10 years from acceptance of the work. Warranty shall state that manufacturer shall repair or replace defective materials if the roofing system leaks or allows the insulation beneath the membrane to become wet during the period of the warranty.

### PART 2 PRODUCTS

#### 2.1 PRIMER

Primer shall conform to ASTM D 41.

#### 2.2 ASPHALT

Asphalt shall conform to ASTM D 312, Type III for slopes up to 25 percent (1/4 vertical/horizontal) and Type IV for slopes up to 50 percent (1/2 vertical/horizontal).

#### 2.3 BITUMINOUS CEMENT

Bituminous cement shall conform to ASTM D 4586.

#### 2.4 CANTS AND WOOD NAILERS

Treated wood cants and wood nailers shall be of water-borne preservative-treated material as specified in Section 06100A ROUGH CARPENTRY. Cants shall be made from treated wood or treated fiberboard not less than 3-1/2 inches high and cut to reduce change in direction of the membrane to 45 degrees or less. Fiberboard shall conform to ASTM C 208, treated with sizing, wax or bituminous impregnation. When membrane or flashing is to be torch applied, cants shall be fire resistant.

#### 2.5 SHEATHING PAPER

Red-rosin type, minimum 3 lb/100 sq. ft., over wood deck substrate.

#### 2.6 BASE SHEET

Non venting base sheet shall conform to ASTM D 4601, Type II.

#### 2.7 MODIFIED BITUMEN SHEET

Modified bitumen sheet shall be a prefabricated styrene-butadiene-styrene modified bitumen sheet and shall comply with ASTM D 6163, Type II, Grade G

or S .

## 2.8 NAILS AND FASTENERS

Nails and fasteners shall be an approved type recommended by the roofing felt or membrane manufacturer.

## 2.9 SURFACING MATERIAL

Surfacing shall be factory applied granules requiring no further coating.

## 2.10 ADHESIVE

Adhesive shall be an approved type recommended by the membrane manufacturer.

# PART 3 EXECUTION

## 3.1 PREPARATION REQUIREMENTS

The substrate construction of any bay or section of the building shall be completed before roofing work is begun thereon. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. Nailers, curbs and other items attached to roof surface shall be in place before roofing is begun.

## 3.2 INSTALLATION OF CANTS

Cants shall be installed in the angles formed between the roof and walls or other vertical surfaces. Cants shall be laid in a solid coat of bituminous cement just prior to laying the base sheet or membrane. Cants shall be continuous, and shall be installed in lengths as long as practicable.

## 3.3 CONDITION OF SURFACES

Surfaces shall be inspected and approved immediately prior to application of roofing and flashings. The roofing and flashings shall be applied to a smooth and firm surface free from ice, frost, visible moisture, dirt, projections, and foreign materials. Modified bitumen membrane shall be isolated from coal tar pitch.

## 3.4 MECHANICAL APPLICATION DEVICES

Mechanical application devices shall be mounted on pneumatic-tired wheels, and shall be designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

## 3.5 PRIMING

Concrete, masonry and metal surfaces to receive bitumen shall be uniformly coated with primer at a rate of not less than 1 gallon per square and allowed to dry.

## 3.6 HEATING OF BITUMEN

Asphalt shall not be heated higher than 75 degrees F above the EVT or 50

degrees F below the flash point or 525 degrees F (maximum) whichever is lower. EVT and flash point temperatures of asphalt in the kettle shall be conspicuously posted on the kettle. Heating kettle shall be provided with automatic thermostatic control and an accurate thermometer (mercury shall not be used in thermometers). Kettle operators shall be in attendance at all times during the heating to ensure that the maximum temperature specified is not exceeded. An asphalt tanker shall be treated as a kettle.

### 3.7 BITUMEN APPLICATION

Asphalt shall be applied within 25 degrees F below or above the EVT, or 400 degrees F, whichever is higher. Application temperatures shall be measured at the mop bucket or mechanical applicator. Bitumen at a temperature below the recommended temperature shall be returned to the kettle.

### 3.8 APPLICATIONS OF BASE SHEET

One course of sheathing paper shall be laid, lapping edges and ends a minimum of 2 inches and 6 inches.

Base sheet shall be applied, shingle fashion, in a continuous operation, with side laps in accordance with manufacturer's printed instructions. End laps shall be not less than 6 inches and staggered a minimum of 24 inches.

Base sheets shall be applied at right angles to the slope (except on curved or steep deck) and laps shall face down the slope. Base sheet course shall be mechanically fastened in conformance with requirements of FM P7825c and the manufacturer's printed instructions.

### 3.9 MODIFIED BITUMEN MEMBRANE APPLICATION

Membrane shall be two plies. Each sheet in each ply shall be fully adhered to the underlying surface. Sheet edges shall lie flat, with no fishmouths or wrinkles. Installation shall begin at the low point of the roof and progress to the high point with each sheet installed shingle fashion. Each sheet shall be unrolled to provide 4 inch side laps and 6 inch end laps. End laps shall be staggered not less than 24 inches. Laps shall not coincide with laps of base layers except at lines of permanent termination. Sheets shall be embedded in hot solid-mopped asphalt, applied at a rate of 20 to 30 pounds per square. Hot asphalt shall flow out of all side and end laps. End laps shall be back-mopped.

### 3.10 TERMINATIONS AT PERIMETERS

The modified bitumen membrane shall extend up abutting surface at least 4 inches or 2 inches above the top of the cant.

### 3.11 MECHANICAL FASTENING

Nails and fasteners for securing base or membrane sheet to wood nailers or deck shall be flush driven through flat metal disks of not less than 1 inch diameter. Metal disks may be omitted where heads of fasteners are equivalent in size to the 1 inch diameter disks. Screw fasteners with disks as specified by the membrane manufacturer shall be used on concrete

or metal deck. Nails and fasteners shall be spaced to meet the wind uplift requirement and within the tolerances specified by the manufacturer. Penetration of nails and fasteners will not be permitted through the exposed surface of membrane.

### 3.12 PROTECTION OF APPLIED ROOFING

At end of day's work or whenever precipitation is imminent, the terminated edge of the roofing shall be sealed with two full width strips of roofing felt set in and coated with bituminous cement or hot mopped asphalt. One half-width of strips shall be extended up and over the finished roofing and the other half-width extended out and onto the bare roof deck or existing membrane. Sealing strips shall be removed before continuing installation of roofing. To facilitate sealing, termination edges may be straightened with pieces of insulation board which shall be removed when work is resumed.

### 3.13 FLASHINGS

Flashings shall be provided over cants, in the angles formed at walls and other vertical surfaces, and where required to make the work watertight. Modified bitumen flashings shall be used, except where metal flashings are specified in other sections of the specifications.

-- End of Section --

## SECTION 07600

FLASHING AND SHEET METAL  
02/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 308	(1999) Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process
ASTM A 653/A 653M	(2001, Rev A) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 32	(2000) Solder Metal
ASTM B 69	(2001, Rev A) Rolled Zinc
ASTM B 101	(2001) Lead-Coated Copper Sheet and Strip for Building Construction
ASTM B 209M	(2001) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 209	(2001) Aluminum and Aluminum Alloy Sheet and Plate
ASTM B 221M	(2000) Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 221	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 226	(1997, Rev A) Asphalt-Saturated Organic



## Felt Used in Roofing and Waterproofing

ASTM D 1784	(1999, Rev A) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 4586	(2000) Asphalt Roof Cement, Asbestos-Free AMERICAN WELDING SOCIETY (AWS)
AWS D1.2	(1997) Structural Welding Code Aluminum  SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)
SMACNA Arch. Manual	(1993) Architectural Sheet Metal Manual

## 1.2 General Requirements

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Application of bituminous strip flashing over various sheet metal items is covered in Section 07510 BUILT-UP ROOFING. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations. Sheet metalwork pertaining to heating, ventilating, and air conditioning is specified in Section 15810 DUCTWORK AND DUCTWORK ACCESSORIES.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Covering on flat, sloped, or curved surfaces; G, AE

Gutters; G, AE

Downspouts; G, AE

Gravel stops and fascias; G, AE

Base flashing; G, AE

Counterflashing; G, AE

Flashing at roof penetrations; G, AE

Reglets; G, AE

Drip edge; G

Eave flashing; G, AE

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

#### SD-11 Closeout Submittals

##### Quality Control Plan

Submit for sheet metal work in accordance with paragraph entitled "Field Quality Control."

#### 1.4 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

#### PART 2 PRODUCTS

##### 2.1 MATERIALS

Lead, lead-coated metal, and galvanized steel shall not be used. Any metal listed by SMACNA Arch. Manual for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in SMACNA Arch. Manual. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items shall be copper.

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. These accessories shall be made of the same materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Sheet metal items shall have mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used except as follows:

#### 2.1.1 Exposed Sheet Metal Items

Shall be of the same material. The following items shall be considered as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fascias; cap, valley, steeped, base, and eave flashings and related accessories.

#### 2.1.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

#### 2.1.3 Copper, Sheet and Strip

ASTM B 370, cold-rolled temper, H 00 (standard).

#### 2.1.4 Aluminum Alloy Sheet and Plate

ASTM B 209, anodized color form alloy, and temper appropriate for use.

##### 2.1.4.1 Finish

Exposed exterior sheet metal items of aluminum shall have a baked-on, factory-applied color coating of polyvinylidene fluoride (PVF2) or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Finish coating dry-film thickness shall be 0.8 to 1.3 mils, and color shall be as selected by Architect from manufacturer's full color range..

#### 2.1.5 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B 221.

#### 2.1.6 Solder

ASTM B 32, 95-5 tin-antimony.

#### 2.1.7 Polyvinyl Chloride Reglet

ASTM D 1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness.

#### 2.1.8 Bituminous Plastic Cement

ASTM D 4586, Type I.

#### 2.1.9 Building Paper

ASTM D 226 Type I .

#### 2.1.10 Asphalt Primer

ASTM D 41.

## 2.1.11 Through-Wall Flashing

Through-wall flashing for masonry is specified in Section 04200, "Unit Masonry."

## 2.1.12 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

## PART 3 EXECUTION

## 3.1 INSTALLATION

## 3.1.1 Workmanship

Make lines, arrises, and angles sharp and true. Free exposed surfaces from visible wave, warp, and buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA Arch. Manual, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

## 3.1.2 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inches. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inches on centers and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work. Sleepers and nailing strips are specified in Section 06100A, "Rough Carpentry."

## 3.1.3 Cleats

Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on centers unless otherwise specified or indicated. Unless otherwise specified, cleats shall be not less than 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Prein cleats for soldered seams.

#### 3.1.4 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Joints in aluminum sheets 0.040 inch or less in thickness shall be mechanically made.

#### 3.1.5 Seams

Straight and uniform in width and height with no solder showing on the face.

##### 3.1.5.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

##### 3.1.5.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inches.

##### 3.1.5.3 Loose-Lock Expansion Seams

Not less than 3 inches wide; provide minimum one inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 1/8 inch thick bed. Sealants are specified in Section 07920N, "Joint Sealants."

##### 3.1.5.4 Standing Seams

Not less than one inch high, double locked without solder.

##### 3.1.5.5 Flat Seams

Make seams in the direction of the flow.

#### 3.1.6 Soldering

Where soldering is specified, it shall apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

##### 3.1.6.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pretinned. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

#### 3.1.7 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than 0.040 inch. Aluminum

0.040 inch or less in thickness shall be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.

#### 3.1.7.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2.

#### 3.1.7.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 12 inches maximum on centers. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2 inches from the end of the overlapping sheet.

#### 3.1.8 Protection from Contact with Dissimilar Materials

##### 3.1.8.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

##### 3.1.8.2 Aluminum

Aluminum surfaces shall not directly contact other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

##### 3.1.8.3 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

##### 3.1.8.4 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

#### 3.1.9 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Where the distance between the last expansion joint and the end of the continuous run is more than half the required interval, an additional joint shall be provided. Space joints evenly. Join extruded aluminum gravel stops and fascias by expansion and contraction joints spaced not more than 12 feet apart.

### 3.1.10 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inches above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inches.

Fold the exposed edges of counterflashings 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths a minimum 8 inch by 8 inch or may be of the preformed one-piece type. Provide end laps in counterflashings not less than 3 inches and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form the flashings to the required shapes before installation. Factory-form the corners not less than 12 inches from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inches apart; on short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Caulking is covered in Section 07920N, "Joint Sealants." Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 1/4 inch and extend not less than 2 inches into the walls. Install counterflashing to provide a spring action against base flashing. Where bituminous base flashings are provided, the counter flashing shall extend down as close as practicable to the top of the cant strip. Counter flashing shall be factory formed to provide spring action against the base flashing.

### 3.1.11 Metal Reglets

Caulked type or friction type reglets shall be factory fabricated with a minimum opening of 1/4 inch and a depth of 1 1/4 inches, as approved.

#### 3.1.11.1 Caulked Reglets

Provide with rounded edges and metal strap brackets or other anchors for securing to the concrete forms. Provide reglets with a core to protect them from injury during the installation. Provide built-up mitered corner pieces for internal and external angles. Wedge the flashing in the reglets with lead wedges every 18 inches, caulked full and solid with an approved compound.

#### 3.1.11.2 Friction Reglets

Provide with flashing receiving slots not less than 5/8 inch deep, one inch jointing tongues, and upper and lower anchoring flanges installed at 24 inches maximum snaplock receiver. Insert the flashing the full depth of the slot and lock by indentations made with a dull-pointed tool, wedges, and filled with a sealant. For friction reglets, install flashing snaplock receivers at 24 inches o.c. maximum. When the flashing has been inserted the full depth, caulk the slot and lock with wedges and fill with sealant.

### 3.1.12 Polyvinyl Chloride Reglets Temporary Construction Installation

Rigid polyvinyl chloride reglets ASTM D 1784, Type II, Grade 1, Class 14333-D, 0.075 inches minimum thickness may be provided in lieu of metal reglets for temporary construction.

### 3.1.13 Gravel Stops and Fascias

Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inches onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascias after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascias on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in as specified in Section 7551A "Modified Bitumen Roofing". Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 1.5 inches long spaced not more than 3 inches on centers, in two staggered rows.

#### 3.1.13.1 Edge Strip

Hook the lower edge of fascias at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on centers. Where fastening is made to concrete or masonry, use screws spaced 12 inches on centers driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16 inch thick compatible spacer or washers.

#### 3.1.13.2 Joints

Leave open the section ends of gravel stops and fascias 1/4 inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4 inches set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fascias in accordance with the manufacturer's printed instructions and details.

### 3.1.14 Metal Drip Edge

Provide a metal drip, designed to allow water run-off to drip free of underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 3 inches and secure with compatible nails spaced not more than 10 inches on center along upper edge.

### 3.1.15 Gutters

The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 3/4 by 3/16 inch of material compatible with gutter. Fabricate gutters in sections not less than 8 feet. Lap the sections a minimum of one inch in the direction of flow or provide with concealed splice plate 6 inches minimum. Join the gutters, other than aluminum, by riveted and soldered



joints. Aluminum gutters shall be joined with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof so that snow and ice can slide clear. Support gutters on adjustable hangers spaced not more than 30 inches on center. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from metals compatible with the gutters.

#### 3.1.16 Downspouts

Supports for downspouts shall be spaced according to the manufacturer's recommendation for the masonry substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on centers with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

##### 3.1.16.1 Terminations

Neatly fit into the drainage connection the downspouts terminating in drainage lines and fill the joints with a portland cement mortar cap sloped away from the downspout. Provide downspouts terminating in splash blocks with elbow-type fittings. Concrete splash block is specified in Section 03300N, "Cast-In-Place Concrete." Provide splash pans as specified.

#### 3.1.17 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 16 by 18 inches. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams and fill with sealer as recommended by aluminum manufacturer. Provide an underlayment of building paper for all sheet metal covering.

#### 3.1.18 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

##### 3.1.19 Single Pipe Vents

See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 3 inches on centers. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inches. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inch roof flange in bituminous plastic cement and

nailed 3 inches on centers. Extend sleeve a minimum of 8 inches above the roof deck and lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant. Sealants are covered under Section 07920N, "Joint Sealants."

### 3.2 PAINTING

Field-paint sheet metal for separation of dissimilar materials. Finish painting is specified in Section 09900, "Paints and Coatings."

#### 3.2.1 Aluminum Surfaces

Shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint as specified in Section 09900, "Paints and Coatings."

### 3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

### 3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

-- End of Section --

## SECTION 07840

FIRESTOPPING  
06/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 119	(2000a) Fire Tests of Building Construction and Materials
ASTM E 814	(2002) Fire Tests of Through-Penetration Fire Stops
ASTM E 1399	(1997; R 2000) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E 1966	(2001) Fire-Resistive Joint Systems

## FM GLOBAL (FM)

FM P7825a	(2003) Approval Guide Fire Protection
FM Standard 4991	(2003) FM Contractor Approval Standard

## UNDERWRITERS LABORATORIES (UL)

UL 723	(1996; Rev thru Sep 2001) Test for Surface Burning Characteristics of Building Materials
UL 1479	(1994; Rev thru Aug 2000) Fire Tests of Through-Penetration Firestops
UL 2079	(1998) Tests for Fire Resistance of Building Joint Systems
UL Fire Resist Dir	(2001) Fire Resistance Directory (2 Vol.)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Firestopping Materials; G, AE.

Detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resist Dir or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" and "T" ratings, and type of application.

### SD-07 Certificates

Firestopping Materials.

Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.

Installer Qualifications.

Documentation of training and experience.

Inspection.

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

## 1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing tested and listed firestop systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the

integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above.

#### 1.4 DELIVERY AND STORAGE

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

#### 1.5 INSTALLER QUALIFICATIONS

The Contractor shall engage an experienced Installer who is:

- a. FM Research approved in accordance with FM Standard 4991, or
- b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

#### 1.6 COORDINATION

The specified work shall be coordinated with other trades. Firestopping materials, at penetrations of pipes and ducts, shall be applied prior to insulating, unless insulation meets requirements specified for firestopping. Firestopping materials at building joints and construction gaps shall be applied prior to completion of enclosing walls or assemblies.

Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Coordinate all firestopping materials and methods with acoustical sealant requirements in Section 07920 JOINT SEALANTS and resiliently-sealed penetration details.

### PART 2 PRODUCTS

#### 2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured, asbestos-free, containing no water soluble intumescent ingredients,

noncombustible products FM P7825a approved for use with applicable construction and penetrating items, complying with the following minimum requirements:

#### 2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resist Dir or by a nationally recognized testing laboratory.

#### 2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application or during fire conditions.

#### 2.1.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resist Dir listed or FM P7825a approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected, except that "F" rating may be 3 hours in through-penetrations of 4 hour fire rated wall or floor. Firestop systems shall also have "T" rating where required.

##### 2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:

- a. Penetrations of Fire Resistance Rated Walls and Partitions: F  
Rating = Rating of wall or partition being penetrated.
- b. Penetrations of Fire Resistance Rated Floors, Floor-Ceiling Assemblies and the ceiling membrane of Roof-Ceiling Assemblies: F  
Rating = Rating of wall or partition being penetrated..

##### 2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose

materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device. Surfaces shall be prepared as recommended by the manufacturer.

### 3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Tested and listed firestop systems shall be provided in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
- d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
- e. Construction joints in floors and fire rated walls and partitions.
- f. Other locations where required to maintain fire resistance rating of the construction.

#### 3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics.

#### 3.2.2 Fire Dampers

Fire dampers shall be installed and firestopped in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

#### 3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products that do not cure over time. Firestopping shall be modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves,

adds or changes without the need to remove or replace any firestop materials.

### 3.3 INSPECTION

For all projects, the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the manufacturer's technical representative. The manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. The Contractor shall submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

-- End of Section --



## SECTION 07920

JOINT SEALANTS  
10/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO (1992) Standard Specification for Highway Bridges, Thirteenth Edition. See Table 25.2B for physical property requirements of bridge bearing-quality neoprene.

ASTM INTERNATIONAL (ASTM)

ASTM C 509	(2000) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 520	(1990) Test Method for Staining and Color Change of Single- or Multi-Component Joint Sealant
ASTM C 570	(2000) Oil- and Resin-Base Caulking Compound for Building Construction
ASTM C 639	(1990) Test Method for Rheological (Flow) Properties of Elastomeric Sealants
ASTM C 719	(1993) Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement
ASTM C 734	(2001) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	(2000) Latex Sealants
ASTM C 919	(2002) Use of Sealants in Acoustical Applications
ASTM C 920	(2000) Elastomeric Joint Sealants
ASTM D 217	(1997) Cone Penetration of Lubricating Grease

ASTM D 412	(1992) Test Method for Vulcanized Rubber and Thermo-Plastic Rubbers and Thermo-Plastic Elastomers/Tensions
ASTM D 1056	(2000) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1667	(1997) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam) **
ASTM D 2240	(1991) Test Method for Rubber Property-Durometer Hardness
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings for Acoustical Sealants

Shop drawings for conduit passing through isolated block-outs in structure. Include durometer, load and deflection calculations for neoprene pads, and location drawing for block-out and lintel.

### SD-03 Product Data

Sealants

Acoustical Sealants

Sheet Caulking

Primers

Bond breakers

Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

### SD-07 Certificates

## Sealant

Certificates of compliance stating that the materials conform to the specified requirements.

Certificate of compliance of bridge bearing quality of neoprene.

## 1.3 ENVIRONMENTAL CONDITIONS

The ambient temperature shall be within the limits of 40 and 90 degrees F when sealant is applied.

## 1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Elastomeric sealant containers shall be labeled to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

## PART 2 PRODUCTS

## 2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

## 2.1.1 Interior Sealant

ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Location(s) of sealant shall be as follows. Color shall match that of adjacent surfaces.

LOCATION	COLOR
a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.	
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	
d. Joints between edge members for acoustical tile and adjoining vertical surfaces.	
e. Interior locations, not otherwise indicated	

LOCATION	COLOR
or specified, where small voids exist between materials specified to be painted.	
f. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.	
g. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.	
h. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	

#### 2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) of sealant shall be as follows. Color shall match that of adjacent surfaces.

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	
b. Joints between new and existing exterior masonry walls.	
c. Masonry joints where shelf angles occur.	
e. Expansion and control joints.	
f. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	
g. Voids where items pass through exterior walls.	
h. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	
i. Metal-to-metal joints where sealant is indicated or specified.	
j. Joints between ends of gravel stops, fascias,	

LOCATION	COLOR
copings, and adjacent walls.	

### 2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Location(s) and color(s) of sealant shall be as follows:

LOCATION	COLOR
a. Seats of metal thresholds for exterior doors.	
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	

### 2.1.4 Acoustical Sealant

#### 2.1.4.1 Properties

Hardness: no more than 50 durometer Shore A as rated in ASTM D 2240.  
Minimum elongation of 500% as rated in ASTM D 412.  
Minimum joint width movement of 25% as rated in ASTM C 719.  
Self-leveling type (S/L) if applied on floors in accordance with ASTM C 639.  
Non-sag type (N/S) if applied on walls in accordance with ASTM C 639.  
Acoustical sealants must meet the following additional requirements where applied in exposed locations:

- Acoustical sealants shall be paintable
- Acoustical sealants shall be skinning type.
- Acoustical sealants shall be non-staining type as rated in ASTM C 510.

#### 2.1.4.2 Acoustical Sealant Manufacturers for Concealed Locations

For concealed locations, acoustical sealants shall be from the following manufacturers. Other manufacturers only as approved by Architect.

- Tremco Acoustical Sealant
- Pecora BA-98
- GE SilPruf SCS2000
- PTI Architectural Sealant
- JM Clipper Duxseal

#### 2.1.4.3 Acoustical Sealant Manufacturers for Exposed Locations

For exposed locations, acoustical sealants shall be from the following manufacturers. Other manufacturers only as approved by Architect.

- STI Spec Seal PEN300
- GE Sanitary 1799

Rhone-Poulenc Rhodorsil 4B or Rhodorsil 5C

#### 2.1.4.4 Acoustical Sealant Manufacturers for Fire-Rated Locations

For fire-rated locations, acoustical sealants shall be from the following manufacturers. Other manufacturers only as approved by Architect.

HILTI CP 601S  
STI Spec Seal ES  
Temco Fyre-Sil

#### 2.1.5 PUTTY PADS

a. Putty pads shall be made from polybutene-butyl with inert fillers or other approved permanently resilient self-adhering materials.

b. Putty pads shall have a minimum thickness of 1/8 inch.

c. For non-rated locations, sheet caulking shall be from the following manufacturers. Other manufacturers only as approved by Architect.

(1) Harry A. Lowry & Associates Outlet Box Pads

d. For fire-rated locations, sheet caulking shall be from the following manufacturers. Other manufacturers only as approved by Architect.

(1) Hevi-Duty Nelson FSP Putty Pads  
(2) STO Spec Seal SSP Putty Pads  
(3) 3M Fire Barrier Putty Pads

#### 2.1.6 PACKING MATERIAL

Packing material shall be of the following types:

(1) Mineral Fiber  
(2) Glass Fiber  
(3) Preformed Pipe Insulation  
(4) Others as approved by the acoustical sealant manufacturer and Architect.

#### 2.1.7 BACKER ROD

Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) O (open-cell material) B (bicellular material with a surface skin) or any of the preceding types, as

approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

#### 2.1.8 SLEEVES

- a. Sleeves shall be made of steel.
- b. Sleeves shall have a minimum gauge of 22.

#### 2.1.9 NEOPRENE PADS

a. Material shall be 3/4 inch minimum thickness waffle pattern or ribbed (both sides) bridge bearing quality neoprene pads. Select pad area for deflection equal to 10 - 15% of unloaded thickness. Place pads for equal loading.

b. Neoprene pad material shall be selected for maximum hardness of 40 durometer, shore A rating, where possible. In no case shall hardness exceed 50 durometer.

- (1) Bridge bearing quality neoprene shall meet AASHTO Highway Bridge Specifications.
- (2) Cork/neoprene pads are not acceptable.
- (3) Pads shall be Mason model SW, Kinetics model NGD or approved equal.

c. Where multiple layers are required to provide the specified minimum thickness, layers of pads shall be interleaved with 16 gauge galvanized steel shim plates.

- (1) Amber-Booth model SP-NR style E or approved equal.

d. See Drawings for additional isolated block-out requirements.

#### 2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

#### 2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

#### 2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

#### 2.4.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1330, Type 2, closed cell, Class A cross section of size and shape to control sealant depth and otherwise contribute to producing optimum sealant performance..

#### 2.4.2 Synthetic Rubber

Synthetic rubber backing shall be ASTM C 509, Option I , Type I preformed rods or tubes.

#### 2.4.3 Neoprene

Neoprene backing shall be ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2.

### 2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Surfaces shall be clean, dry to the touch, and free from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

#### 3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

#### 3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

#### 3.1.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.



## 3.1.4 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

## 3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

## 3.3 APPLICATION

## 3.3.1 Joint Width-To-Depth Ratios

## a. Acceptable Ratios:

<u>JOINT WIDTH</u>	<u>JOINT DEPTH</u>	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, or stone:		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inches	1/2 inch	5/8 inch
Over 2 inches	(As recommended by sealant manufacturer)	

- b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding shall not be required on metal surfaces.

## 3.3.2 Masking Tape

Masking tape may be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

## 3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or

bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

- a. Where indicated.
- b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios."

#### 3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

#### 3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

#### 3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Sealant shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

### 3.4 APPLICATION REQUIREMENTS FOR ACOUSTICAL SEALANTS

#### 3.4.1 Extent of Acoustical Sealants

- a. Resiliently seal all penetrations (conduit, duct, pipe, cable, recessed boxes, etc.) using acoustical sealant and/or sheet caulking through all walls, floors, and ceilings of the following spaces:
  - (1) As indicated on the drawings.
  - (2) Mechanical and electrical rooms.
  - (3) Rooms containing motorized theatrical equipment, sound racks, dimmer racks, or any other equipment that contains a transformer, fan or motor.
  - (4) Spaces with background noise level criteria of RC 25 and lower.
- b. Isolated block-outs shall be used where multiple conduit penetrations

make individual resilient seals impractical, where shown on drawings, and optionally where preferred to multiple individual resilient seals.

- c. At double-wall or triple-wall partitions, resiliently seal penetrations at each wall.
- d. Request clarification of extent from the Architect for any uncertain conditions.

### 3.4.2 Application of Acoustical Sealants

#### 3.4.2.1 Opening Requirements

- a. In stud assemblies, each penetrant must be housed in an individual opening properly sized for that penetrant. Routing multiple penetrants through a single opening is not allowed. The following requirements apply:
  - (1) Provide a minimum of 2x wood blocking or 2 layers of 3/4" plywood between studs for pipe, conduit, cable, and round duct penetrants.
  - (2) Frame openings for rectangular duct penetrants.
  - (3) The space between the opening and the penetrant shall be 1/2-inch minimum to 3/4-inch maximum around the penetrant. The penetrant shall be centered within the opening so that there is no contact between the opening and the penetrant.
- b. In masonry or precast concrete assemblies, each penetrant must be housed in an individual opening properly sized for that penetrant. Routing multiple penetrants through a single opening is not allowed. The following requirements apply:
  - (1) At masonry assemblies, properly form openings to minimize the grout needed between the opening and the sleeve.
  - (2) Provide sleeves that are grouted in place. Sleeve ends shall be flush with surrounding substrates. Provide infill around all sleeves with material of surface weight equal to or greater than the surrounding substrate. All void spaces between sleeve and masonry or precast concrete must be filled airtight.
  - (3) In grout-filled masonry or precast concrete, properly sized core drilled holes may be used in lieu of sleeves.
  - (4) The space between the sleeve and the penetrant shall be 1/2-inch minimum to 3/4-inch maximum around the penetrant. The penetrant shall be centered within the opening so that there is no contact between the sleeve and the penetrant.
  - (5) At multi-wythe partitions, provide separate sleeves at each wythe. Sleeves may not bridge airspace(s) of multi-wythe partitions.
- c. In poured concrete assemblies, penetrants can be housed in an individual opening properly sized for that penetrant or housed in an opening properly sized for several penetrants. When multiple penetrants are housed in a single opening, the following requirements apply:
  - (1) Each penetrant must be sleeved.
  - (2) Sleeve ends shall be flush with surrounding substrates. Provide

infill around all sleeves with material of surface weight equal to or greater than the surrounding substrate. All void spaces between sleeves and concrete must be filled airtight.

- (3) The space between the sleeve and the penetrant shall be ½-inch minimum to ¾-inch maximum around the penetrant. The penetrant shall be centered within the opening so that there is no contact between the sleeve and the penetrant.
- (4) At multi-wythe partitions, provide separate sleeves at each wythe. Sleeves may not bridge airspace(s) of multi-wythe partitions.

#### 3.4.2.2 Clearances

- a. Maintain a 4-inch minimum clear space around duct penetrations so that an airtight seal can be easily installed without conflicts from nearby penetrants, floors, ceilings, walls, or other obstructions.
- b. Maintain a 2-inch minimum clear space around all other penetrations so that an airtight seal can be easily installed without conflicts from nearby penetrants, floors, ceilings, walls, or other obstructions.

#### 3.4.2.3 Sealing

- a. Do not proceed with installation if opening requirements or other requirements specified herein are not met.
- b. Prepare and install backer rod material in accordance with manufacturer's recommendations for proper application of sealant.
- c. Loosely fill space between opening or sleeve and penetrant with clean packing material to be nearly flush with both ends of opening or sleeve.
- d. Seal both ends of penetration with liberal bead of sealant applied continuously around the penetration and jointed end-to-end to form an airtight, continuous membrane.
  - (1) Sealant shall completely fill the space surrounding the penetrant.
  - (2) Sealant thickness shall be as recommended by the manufacturer, no less than ¼-inch.
- e. When complete, sealant shall be flush with surrounding substrate.

#### 3.4.3 Putty Pads

- a. Brush or wipe construction dust and dirt from recessed box.
  - (1) If surface is contaminated with oil, wipe with xylene or toluene to remove oily residue.
- b. Before mounting recessed box or attaching conduit, adhere sheet caulking to box back and mounting side(s). Leave ½-inch minimum overlap along the front surface to enable wrapping of plaster ring.
- c. Mount recessed box and install plaster ring. Tighten all loose fasteners.
- d. Continue wrapping recessed box, all conduit attachments and plaster ring with sheet caulking. Press sheet caulking firmly into surfaces.
  - (1) If necessary, cut and apply additional pieces of sheet caulking to achieve an airtight seal around the recessed box, conduit

attachments, and plaster ring.

- e. After gypsum board installation, press sheet caulking firmly against gypsum board to create an airtight seal.

- (1) If airtight seal is not continuous around the plaster ring perimeter, seal any gaps or voids with a liberal bead of acoustical sealant to create an airtight seal.

#### 3.4.4 Isolated Block-Outs

- a. Coordinate with other trades for precast concrete block and lintel.
- b. Size neoprene pad and select neoprene durometer to meet specified percentage deflection.
- c. Install neoprene pads, perimeter material and acoustical sealant to prevent rigid contact between block and adjacent structure.
- d. Grout conduit through sleeves airtight and to full depth of sleeve.
- e. Conduit on either side of block shall be supported to prevent transfer of additional weight to the pads supporting the block.
- f. Use permanently resilient non-hardening firestopping sealants where penetrating fire-rated assemblies.

### 3.5 PROTECTION AND CLEANING

#### 3.5.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

#### 3.5.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

- a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.
- b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

## SECTION 08110

## STEEL DOORS AND FRAMES

05/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.3	(1999) Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
ANSI A250.4	(1994) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings
ANSI A250.6	(1997) Hardware on Standard Steel Doors (Reinforcement - Application)
ANSI A250.8	(1998) SDI-100 Recommended Specifications for Standard Steel Doors and Frames

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 591	(1998) Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

ASTM C 612	(1993) Mineral Fiber Block and Board Thermal Insulation
ASTM D 2863	(1997) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E 283	(1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

## DOOR AND HARDWARE INSTITUTE (DHI)

BHMA A115	(1991) Steel Door Preparation Standards (Consisting of A115.1 through A115.6 and A115.12 through A115.18)
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## HOLLOW METAL MANUFACTURERS ASSOCIATION (HMMA)

NAAMM HMMA HMM	(1992) Hollow Metal Manual
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows
NFPA 105	(1999) The Installation of Smoke-Control Door Assemblies
NFPA 252	(1999) Standard Methods of Fire Tests of Door Assemblies

## STEEL DOOR INSTITUTE (SDOI)

SDI 105	(1998) Recommended Erection Instructions for Steel Frames
SDI 111-B	Recommended Standard Details for Dutch Doors
SDI 111-C	Recommended Louver Details for Standard Steel Doors
SDI 111-F	Recommended Existing Wall Anchors for Standard Steel Doors and Frames
SDI 113	(1979) Apparent Thermal Performance of STEEL DOOR and FRAME ASSEMBLIES

## UNDERWRITERS LABORATORIES (UL)

UL 10B	(1997) Fire Tests of Door Assemblies
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## 1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

### SD-02 Shop Drawings

Doors; G, AE

Frames; G, AE

Accessories, AE

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G, AE

Schedule of frames; G, AE

Submit door and frame locations.

### SD-03 Product Data

Doors; G, AE

Frames; G, AE

Accessories, AE

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to ANSI A250.8 requirements.

## 1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

## PART 2 PRODUCTS

### 2.1 STANDARD STEEL DOORS

ANSI A250.8, except as specified otherwise. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to



prevent water intrusion. Doors shall be 1 3/4 inches thick, unless otherwise indicated.

#### 2.1.1 Classification - Level, Performance, Model

##### 2.1.1.1 Heavy Duty Doors

ANSI A250.8, Level 2, physical performance Level B, Model 1 , with core construction as required by the manufacturer for interior doors , of size(s) and design(s) indicated.

##### 2.1.1.2 Extra Heavy Duty Doors

ANSI A250.8, Level 3, physical performance Level A, Model 3 with core construction as required by the manufacturer for exterior doors, of size(s) and design(s) indicated. Where vertical stiffenercores are required, the space between the stiffeners shall be filled with mineral board insulation.

#### 2.2 CUSTOM HOLLOW METAL DOORS

Provide custom hollow metal doors where nonstandard steel doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of standard steel doors. Door size(s), design, materials, construction, gages, and finish shall be as specified for standard steel doors and shall comply with the requirement of NAAMM HMMA HMM. Fill all spaces in doors with insulation. Close top and bottom edges with steel channels not lighter than 16 gage. Close tops of exterior doors flush with an additional channel and seal to prevent water intrusion. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut doors where indicated. Doors shall be 1 3/4 inches thick, unless otherwise indicated.

#### 2.3 ACCESSORIES

##### 2.3.1 Louvers

##### 2.3.1.1 Interior Louvers

SDI 111-C, Louvers shall be stationary type where scheduled. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 20 gage steel and louver blades of a minimum 24 gage.

##### 2.3.2 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08710, "Door Hardware," provide overlapping steel astragals with the doors. .

#### 2.4 INSULATION CORES

Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI 113 and shall conform to:

- a. Rigid Polyurethane Foam: ASTM C 591, Type 1 or 2, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or
- b. Rigid Polystyrene Foam Board: ASTM C 578, Type I or II; or
- c. Mineral board: ASTM C 612, Type I.

## 2.5 STANDARD STEEL FRAMES

ANSI A250.8, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, transoms, sidelights, mullions, unless otherwise indicated.

### 2.5.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

### 2.5.2 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and shall member with heads and jambs butt-welded thereto. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

### 2.5.3 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inches on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

### 2.5.4 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

#### 2.5.4.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

- a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;
- b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to wood studs with nails, to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

- c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI 111-F.

## 2.6 FIRE DOORS AND FRAMES

NFPA 80 and this specification. The requirements of NFPA 80 shall take precedence over details indicated or specified.

### 2.6.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

### 2.6.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

## 2.7 WEATHERSTRIPPING

As specified in Section 08710, "Door Hardware."

## 2.8 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in ANSI A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of ANSI A250.8 and ANSI A250.6. For additional requirements refer to BHMA A115.

Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of ANSI A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping or lightproof or soundproof gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

## 2.9 FINISHES

### 2.9.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in ANSI A250.8, or paintable A25 galvanized steel without primer. Where coating is removed by welding, apply touchup of factory primer.

### 2.9.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924M and ASTM A 653/A 653M. The Coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in ANSI A250.8. Provide for exterior doors .

### 2.9.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A 591, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in ANSI A250.8.

## 2.10 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

### 2.10.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Where frames require ceiling struts or overhead bracing, anchor frames to the struts or bracing. Backfill frames with mortar. When an additive is provided in the mortar, coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

#### 3.1.2 Doors

Hang doors in accordance with clearances specified in ANSI A250.8. After

erection and glazing, clean and adjust hardware.

### 3.1.3 Fire Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80.

### 3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

### 3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --

## SECTION 08165A

SLIDING WOOD DOORS  
11/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2003) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM E 330	(2002) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000) Industrial Controls and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
NEMA ICS 6	(1993; R 2001) Industrial Control and Systems: Enclosures
NEMA MG 1	(1998) Motors and Generators

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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## UNDERWRITERS LABORATORIES (UL)

UL 14B	(1998) Sliding Hardware for Standard, Horizontally Mounted Tin-Clad Fire Doors
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WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17	(1996; Supples VII(A-E), VIII(A-C)) Grading Rules for West Coast Lumber
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

#### Sliding Metal Doors; G, AE

Drawings including elevations of each door type, details of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of tracks, rollers, power operators, controls, and fittings. A schedule showing the location of each door shall be included with the drawings. Manufacturer's catalog data shall be included.

## 1.3 DESIGN REQUIREMENTS

Sliding doors shall conform to NFPA 80 and the requirements specified herein. Each door shall be complete with operating devices, hardware, and accessories. Minimum design wind load shall be 27 psf. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load and shall not deflect more than 1/120 of the door width and height. When tested in accordance with the static air pressure test procedure of ASTM E 330, the door shall support the superimposed loads for a minimum period of 10 seconds without evidence of serious damage and shall be operable after conclusion of the tests. As an option, tests shall be conducted using an equivalent uniform static load. The uniform static load test specimen shall be supported using rollers and track as required for project installation. Recovery shall be at least three-fourths of the maximum deflection within 24 hours after the test load is removed.

## 1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering, with the brands and names clearly marked thereon. Doors shall be stored in an adequately ventilated, dry location that is free from dust, water, or other contaminants and in a manner that permits access for inspection and handling. Doors shall be handled carefully to prevent damage to the faces, edges, and ends. Damaged items that cannot be restored to like-new condition shall be replaced.

## 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## 1.6 OPERATION AND MAINTENANCE MANUALS

Manufacturer's installation, operation, and maintenance instructions for sliding metal doors shall be provided.

## PART 2 PRODUCTS

### 2.1 SLIDING DOORS

Sliding doors shall be of the following types:

#### 2.1.1 Wood Stile and Rail

Doors shall be stile and rail construction. Stiles shall be of dimensions indicated. Panels shall be made of tongue and groove 1-3/4 inch strips.

Construction: Stiles and rails shall be joined with mortise and tenon joints, screwed and glued. . Panels shall be joined by gluing and screwing the tongue and grooves. The screws shall be 3-1/4" long and extend through one and one-half strips. The screws shall be no further than 9" apart and shall be arranged in a staggered fashion. Panels shall be set into grooved stile and rail, with 1/4" clearance allowing for expansion and contraction.

Wood species: Stiles, rails and panel components shall be constructed of vertical grain Douglas fir, WCLIB Grade C or better, kiln dried to 12% to 15% moisture content.

### 2.2 OPERATION

Doors shall be center-parting on level tracks and shall be designed to normally remain in the closed position but permit normal operation for passage. Doors shall be power operated. Automatic closing system shall be a labeled automatic reel type closer .

#### 2.2.1 Power Operators

The operator shall be of the electric type conforming to NFPA 80 and the requirements specified herein. Readily adjustable limit switches shall be provided to automatically stop the door in its full open or closed position. All operating devices shall be suitable for the Class, Division, and Group shown and as defined in NFPA 70.

#### 2.2.2 Electric Operators

The operator shall be heavy-duty industrial type designed to operate the door at not less than 1 foot per second. Electrical controls shall be push button wall switches as indicated. Electric power operators shall be complete with electric motor, brackets, controls, limit switches, magnetic reversing starter, and all other accessories necessary. The operator shall be designed so that the motor may be removed without disturbing the limit-switch timing. The power operator shall be provided with a slipping clutch coupling or torque limiter, as required to prevent stalling of the motor. Operators shall have provisions for immediate emergency manual



operation of the door in case of electrical failure. Where control voltages differ from motor voltage, a control voltage transformer shall be provided in and as part of the starter. Control voltage shall be 120 volts or less. Control shall be electrical, conforming to NEMA ICS 2 and NEMA ICS 6. Enclosures shall be Type 12 (industrial use), with push button wall switches.

#### 2.2.2.1 Motors

Drive motors shall conform to NEMA MG 1, shall be high-starting torque, reversible type, and shall be of sufficient power and torque output to move the door in either direction from any position at the required speed without exceeding the rated capacity. Motors shall be suitable for operation on 480 volts, 60 hertz, three phase, and shall be suitable for across-the-line starting. Motors shall be designed to operate at full capacity over a supply voltage variation of plus or minus 10 percent of the motor voltage rating.

#### 2.2.2.2 Controls

Each door motor shall have thermal overload protection, limit switches, and remote-control switches. The control equipment shall conform to NEMA ICS 2.

Enclosures shall be NEMA ICS 6 Type 12 (industrial use), Type 7 or 9 in hazardous locations, or as otherwise indicated. Each switch location shall include a wall control station for each of the two doors openings. Each wall control station shall be of the three-button type, with the controls marked "OPEN," "CLOSE," and "STOP." When the door is in motion and the "STOP" control is pressed, the door shall stop instantly and remain in the stop position; from the stop position, the door shall be operable in either direction by the "OPEN" or "CLOSE" controls. Controls shall be of the full-guarded type to prevent accidental operation.

Radio Control System: Each sliding door motor shall be provided with a solid state radio control system. System shall comply with all FCC regulations, carry frequencies available from 186 to 320 MHz, allow 19,683 possible code combinations per carrier frequency. Receiver shall operate on 115 VAC. Three (3) transmitters shall be provided. Each transmitter shall operate on a standard 9 volt battery. Transmitter shall include three individual open-close-stop buttons and operation indicator lights, and a two-position slide switch for two individual doors.

#### 2.2.3 Electrical Work

Conduit and wiring necessary for proper operation shall be provided in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Flexible connections between doors and fixed supports shall be made with extra flexible type SO cable, except in hazardous locations where wiring shall conform to NFPA 70. The cable shall have spring-loaded automatic take-up reel coil cord or an equivalent and approved device.

#### 2.3 SAFETY DEVICE

The leading edge of doors shall have a safety device that will immediately reverse the door movement upon contact with an obstruction and cause the

door to return to its full open position. The safety device shall not substitute for a limit switch. Exterior doors shall be provided with a combination weather seal and safety device.

## 2.4 HARDWARE

Hardware shall conform to NFPA 80, UL 14B and the requirements specified herein. Tracks, roller assemblies, and installation hardware shall be designed to support a dead load equal to 1-1/2 times the weight of the door and attached hardware without deformation that would interfere with the operation of the door. Tracks shall be formed of galvanized G90 steel not lighter than 14 gauge. Ball or roller bearing wheels shall be provided on all devices incorporating wheels or rollers. Hardware shall be attached using zinc plated through bolts, nut plates, or similar devices to ensure adequate fastener strength. Recessed steel pulls shall be provided on both sides of all door leaves. Closing system for sliding doors shall be controlled speed cable reels.

## 2.5 ACCESSORIES

### 2.5.1 Track Hood

Track hood for exterior doors mounted on the exterior face of the wall shall be zinc-coated steel not lighter than 18 gauge.

### 2.5.2 Weatherstripping

Weatherstripping shall be provided on head, jamb, and sills of exterior doors. Weatherstripping shall be 1/16 inch thick fabric-reinforced neoprene, and shall have continuous metal retainers.

### 2.5.3 Latching Device

Heavy-duty cane bolt shall be provided at each door leaf. Bolt shall be operable from the inside, and shall lie flat and not impede travel of sliding door.

### 2.5.4 Pass Door

A pass door of nominal size as shown shall be furnished complete with an integral frame. The pass door shall be factory installed and fitted. The pass door shall have hardware as specified under Section 08710 DOOR HARDWARE.

## 2.6 FINISH

### 2.6.1 Steel Surfaces of Exterior Doors

Steel surfaces of exterior doors shall be provided with a galvanized coating. Exposed surfaces shall be provided with a shop-primed finish in addition to the galvanized coating. Galvanizing shall conform to ASTM A 653/A 653M or ASTM A 924/A 924M, coating designation G90, for steel sheets.

Prior to receiving primer, all surfaces shall be cleaned and phosphate-treated for maximum paint adherence. Primer shall be metallic

oxide or synthetic resin primer of the manufacturer's standard type and shall be applied by dipping or spraying.

#### 2.6.2 Wood Surfaces

Before installation wood doors shall be treated with a high-quality preservative to reduce moisture penetration.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Doors shall be installed in accordance with NFPA 80, approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, motors, switches, hardware, and accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Exterior doors shall be weather tight. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

#### 3.2 FIELD FINISHING

Doors to receive field finish shall be finished in accordance with Section 09900 PAINTING, GENERAL. Color shall be clear.

-- End of Section --

## SECTION 08210

WOOD DOORS  
**09/99**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 90	(1997) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E 152	(1981; Rev. A) Fire Tests of Door Assemblies
ASTM E 283	(1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

## ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(1997) Architectural Woodwork Quality Standards and Quality Certification Program
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## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Fire Windows
NFPA 252	(1995) Fire Tests of Door Assemblies

## WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	(1993) Architectural Wood Flush Doors
WDMA I.S. 4	(1994) Water-Repellent Preservative Non-Pressure Treatment for Millwork
WDMA I.S. 6	(1991) Wood Stile and Rail Doors
WDMA TM-5	(1990) Split Resistance Test

WDMA TM-7 (1990) Cycle - Slam Test

WDMA TM-8 (1990) Hinge Loading Resistance Test

UNDERWRITERS LABORATORIES (UL)

UL 10B (1997) Fire Tests of Door Assemblies

## 1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

### SD-02 Shop Drawings

Doors; G, AE

Submit drawings or catalog data showing each type of door unit ; descriptive data of head and jamb weatherstripping with installation instructions shall be included. Drawings and data shall indicate door type and construction, sizes, thickness, methods of assembly, door louvers, and glazing,.

### SD-03 Product Data

Doors; G

Accessories

Water-resistant sealer

Sample warranty

Fire resistance rating; G

### SD-04 Samples

Doors, AE

Prior to the delivery of wood doors, submit a sample section of each type of door which shows the stile, rail, veneer, finish, and core construction.

### SD-06 Test Reports

Split resistance

Cycle-slam

Hinge loading resistance

Submit split resistance test report for doors tested in accordance with WDMA TM-5, cycle-slam test report for doors tested in

accordance with WDMA TM-7, and hinge loading resistance test report for doors tested in accordance with WDMA TM-8.

### 1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4 inches thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

### 1.4 WARRANTY

Warranty shall warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

## PART 2 PRODUCTS

### 2.1 DOORS

Provide doors of the types, sizes, and designs indicated .

#### 2.1.1 Stile and Rail Doors

Standard grade Ponderosa Pine stile and rail doors conforming to WDMA I.S. 6. When laminated panels are furnished, they shall be not less than three ply. Flat panels shall have a minimum finished panel thickness of 1/2 inch. Raised panels shall have a minimum finished panel thickness of 3/4 inch.

#### 2.1.2 Flush Doors

Flush doors shall conform to WDMA I.S. 1-A, Custom grade. Stile edge bands of doors to receive natural finish shall be hardwood, compatible with face veneer. Stile edge bands of doors to be painted shall be mill option specie. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware.

##### 2.1.2.1 Interior Flush Doors

Grade: WDMA I.S.1-A Custom, Grade A faces.

Species and Cut: White Maple, plain sliced.

Match between Veneer Leaves: Book match.

Assembly of Veneer Leaves on Door Faces: Balance match.

Core: Structural composite lumber.

Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

### 2.1.3 Fire Doors

Doors specified or indicated to have a fire resistance rating shall conform to the requirements of UL 10B, ASTM E 152, or NFPA 252 for the class of door indicated. Affix a permanent metal label with raised or incised markings indicating testing agency's name and approved hourly fire rating to hinge edge of each door.

Construction: core as specified above or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.

## 2.2 ACCESSORIES

### 2.2.1 Door Louvers

Fabricate from wood and of sizes indicated. Louvers shall be of the manufacturer's standard design and shall transmit a minimum of 35 percent free air. Louvers shall be the sightproof inverted vee slat type. Mount louvers in the door with flush wood moldings .

### 2.2.2 Door Light Openings

Provide glazed openings with the manufacturer's standard wood moldings except that moldings for doors to receive natural finish shall be of the same specie and color as the face veneers. Moldings on exterior doors shall have sloped surfaces. Provide glazed openings in fire-rated doors with fire rated frames. Glazing is specified in Section 08800N, "Glazing."

### 2.2.3 Additional Hardware Reinforcement

Provide fire rated doors with hardware reinforcement blocking. Size of lock blocks shall be as required to secure the hardware specified. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements and shall not be mineral material similar to the core.

## 2.3 FABRICATION

### 2.3.1 Marking

Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door.

### 2.3.2 Quality and Construction

Identify the standard on which the construction of the door was based , identify the standard under which preservative treatment was made, and identify doors having a Type I glue bond.

### 2.3.3 Preservative Treatment

Exterior doors shall be water-repellent preservative treated and so marked at the plant in accordance with WDMA I.S. 4.

#### 2.3.4 Adhesives and Bonds

WDMA I.S. 1-A. Use Type I bond for exterior doors and Type II bond for interior doors. Adhesive for doors to receive a natural finish shall be nonstaining.

#### 2.3.5 Prefitting

At the Contractor's option, doors may be provided factory pre-fit. Doors shall be sized and machined at the factory by the door manufacturer in accordance with the standards under which they are produced. The work shall include sizing, bevelling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules as required to coordinate the work.

#### 2.3.6 Finishes

##### 2.3.6.1 Field Painting

Factory prime or seal doors, and field paint as specified in Section 09900, "Paints and Coatings."

##### 2.3.6.2 Factory Finish

Provide doors finished at the factory by the door manufacturer as follows: AWI Qual Stds Section 1500, specification for System No. 4 Conversion varnish alkyd urea or System No. 5 Vinyl catalyzed. The coating shall be AWI Qual Stds premium, medium rubbed sheen, closed grain effect. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

##### 2.3.6.3 Color

Provide clear door finish.

#### 2.3.7 Water-Resistant Sealer

Provide a water-resistant sealer compatible with the specified finishes as approved and as recommended by the door manufacturer.

#### 2.4 SOURCE QUALITY CONTROL

Stiles of "B" and "C" label fire doors utilizing standard mortise leaf hinges shall meet the following performance criteria:

- a. Split resistance: Average of ten test samples shall be not less than 500 pounds load when tested in accordance with WDMA TM-5.
- b. Cycle-slam: 200,000 cycles with no loose hinge screws or other



visible signs of failure when tested in accordance with the requirements of WDMA TM-7.

- c. Hinge loading resistance: Average of ten test samples shall be not less than 700 pounds load when tested for direct screw withdrawal in accordance with WDMA TM-8 using a No. 12, 1 1/4 inch long, steel, fully threaded wood screw. Drill 5/32 inch pilot hole, use 1 1/2 inch opening around screw for bearing surface, and engage screw full, except for last 1/8 inch. Do not use a steel plate to reinforce screw area.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 1/16 inch minimum, 1/8 inch maximum clearance at sides and top, and a 3/16 inch minimum, 1/4 inch maximum clearance over thresholds. Provide 3/8 inch minimum, 7/16 inch maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 1/8 inch in 2 inches. Door warp shall not exceed 1/4 inch when measured in accordance with WDMA I.S. 1-A.

##### 3.1.1 Fire Doors

Install fire doors in accordance with NFPA 80. Do not paint over labels.

##### 3.1.2 Weatherstripping

Install doors in strict accordance with the manufacturer's printed instructions and details. Weatherstrip exterior swing-type doors at sills, heads and jambs to provide weathertight installation. Apply weatherstripping at sills to bottom rails of doors and at meeting stiles of exterior double-doors as specified under Section 08710, "Door Hardware".

-- End of Section --

SECTION 08520A

ALUMINUM AND ENVIRONMENTAL CONTROL ALUMINUM WINDOWS  
**10/03**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101 (1997) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

AAMA 1503 (1998) Voluntary Test Method for Thermal Transmittance and Condensation REsistance of Windows, Doors, and Glazed Wall Sections.

AAMA 2604 (2002) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3656 (1997) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

ASTM E 90 (1999) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

ASTM E 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 330 (1997e1) Structural Performance of Exterior Windows, Curtain Walls, and Doors

by Uniform Static Air Pressure Difference

ASTM E 331 (1996) Water Penetration of Exterior  
Windows, Curtain Walls, and Doors by  
Uniform Static Air Pressure Difference

ASTM E 413 (1987; R 1999) Rating Sound Insulation

ASTM E 547 (1996) Water Penetration of Exterior  
Windows, Curtain Walls, and Doors by  
Cyclic Static Air Pressure Differential

ASME INTERNATIONAL (ASME)

ASME A39.1 (1995; A39.1a; A39.1b) Safety Requirements  
for Window Cleaning

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089 (1990) Recommended Standards and  
Specifications for Insect Wire Screening  
(Wire Fabric)

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100 (1997) Procedure for Determining  
Fenestration Product U-factors

NFRC 200 (1997) Procedure for Determining  
Fenestration Product Solar Heat Gain  
Coefficients at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (1997; Errata 97-1; TIA-97-1) Life Safety  
Code

SCREEN MANUFACTURERS ASSOCIATION (SMA)

SMA 1004 (1987) Aluminum Tubular Frame Screens for  
Windows

1.2 WINDOW PERFORMANCE

Aluminum windows shall meet the following performance requirements.  
Testing requirements shall be performed by an independent testing  
laboratory or agency.

1.2.1 Structural Performance

Structural test pressures on window units shall be for positive load  
(inward) and negative load (outward) in accordance with ASTM E 330. After

testing, there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There shall be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA 101 for the window types and classification specified in this section.

#### 1.2.2 Air Infiltration

Air infiltration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 283.

#### 1.2.3 Water Penetration

Water penetration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 547 .

#### 1.2.4 Thermal Performance

Thermal transmittance for thermally broken aluminum windows with insulating glass shall not exceed a U-factor of .040 Btu/hr-ft<sup>2</sup>-F determined according to NFRC 100, and a solar heat gain coefficient (SHGC) of 0.55 Btu/hr-ft<sup>2</sup>-F determined according to NFRC 200. Window units shall comply with the U.S. Department of Energy, Energy Star Window Program for the Central Climate Zone..

#### 1.2.5 Condensation Index Rating

The condensation resistance factor rating shall be CRF 45 for frame and CRF 50 for glass as determined by AAMA 1503.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Aluminum Windows; G, AE

Drawings indicating elevations of window, rough-opening dimensions for each type and size of window, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details, weatherstripping details, , and window schedules showing locations of each window type.

#### SD-03 Product Data

Aluminum Windows;

Manufacturer's descriptive data and catalog cut sheets.

Manufacturer's preprinted installation instructions and cleaning instructions.

SD-04 Samples

Aluminum Windows; G, AE

Submit three color samples of the specified finishes.

SD-06 Test Reports

Aluminum Windows;

Reports for each type of aluminum window attesting that identical windows have been tested and meet all performance requirements established under paragraph WINDOW PERFORMANCE.

SD-07 Certificates

Aluminum Windows;

Certificates stating that the aluminum windows are AAMA certified conforming to requirements of this section. Labels or markings permanently affixed to the window will be accepted in lieu of certificates. Product ratings determined using NFRC 100 and NFRC 200 shall be authorized for certification and properly labeled by the manufacturer.

1.4 QUALIFICATION

Window manufacturer shall specialize in designing and manufacturing the type of aluminum windows specified in this section, and shall have a minimum of 10 years of documented successful experience. Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.5 DELIVERY AND STORAGE

Aluminum windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Damaged windows shall be replaced with new windows.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

## 2.1 ALUMINUM WINDOW TYPES

Aluminum windows shall consist of complete units including sash, glass, frame, weatherstripping, , and hardware. Windows shall conform to AAMA 101.

Windows shall be thermal break type double-glazed. Thermal barrier shall be neoprene, rigid vinyl, or polyurethane and shall be resistant to weather. Window members shall be heli-arc welded or angle-reinforced and mechanically joined and sealed. Exposed welded joints shall be dressed and finished. Joints shall be permanent and weathertight. Frames shall be constructed to provide a minimum 1/4 inch thermal break between the exterior and interior frame surfaces. Sash corners shall be internally sealed to prevent air and water leaks.

## 2.1.1 Awning/Hopper/Projected Windows

Aluminum awning (A),hopper and projected windows shall conform to AAMA 101 Designation AP-C65 type consisting of hinged ventilators arranged in a single or vertical series within a common frame. Ventilators shall be equipped with concealed stainless steelfour-bar friction hinges . Operating hardware, except ventilator arms and rotary operators, shall be concealed within frame and sill. Ventilator arms shall be concealed when windows are closed. Operable sashes shall be provided with a stainless steel limit arm with release key.

## 2.1.2 Fixed Windows

Aluminum fixed (F) windows shall conform to AAMA 101 F-C65 type, non-operable glazed frame.

## 2.2 WEATHERSTRIPPING

Weatherstripping for ventilating sections shall be of type designed to meet water penetration and air infiltration requirements specified in this section in accordance with AAMA 101, and shall be manufactured of material compatible with aluminum and resistant to weather. Weatherstrips shall be factory-applied and easily replaced in the field. Neoprene or polyvinylchloride weatherstripping are not acceptable where exposed to direct sunlight.

## 2.3 INSECT SCREENS

Insect screens shall be aluminum window manufacturer's standard design, and shall be provided where scheduled on drawings. Insect screens shall be fabricated of extruded tubular-shaped aluminum frames conforming to SMA 1004 and (18 x 16) aluminum mesh screening conforming with ISWA IWS 089, Type III .

## 2.4 ACCESSORIES

## 2.4.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from

aluminum, non-magnetic stainless steel, cadmium-plated steel, nickel/chrome-plated steel in compliance with AAMA 101. Self-tapping sheet metal screws will not be acceptable for material thicker than 1/16 inch.

#### 2.4.2 Hardware

Hardware shall be as specified for each window type and shall be fabricated of aluminum, stainless steel, cadmium-plated steel, zinc-plated steel or nickel/chrome-plated steel in accordance with requirements established by AAMA 101.

#### 2.4.3 Window Anchors

Anchoring devices for installing windows shall be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA 101.

### 2.5 GLASS AND GLAZING

Aluminum windows shall be designed for inside glazing, and for glass types scheduled on drawings and specified in Section 08810 GLASS AND GLAZING.

Units shall be complete with glass and glazing provisions to meet AAMA 101.

Glazing material shall be compatible with aluminum, and shall not require painting.

### 2.6 FINISH

#### 2.6.1 High-Performance Coating

Exposed surfaces of aluminum windows shall be finished with a two-coat fluoropolymer coating system containing at least 70 percent by weight polyvinylidene fluoride, PVF2 resin, factory-applied, oven-baked, conforming to AAMA 2604, with a primer coat of 0.20 to 0.30 mils and a color coat of minimum 1.0 mil, total dry film thickness of 1.20 to 1.3 mils.

Finish shall be free of scratches and other blemishes.

#### 2.6.2 Color

Color shall be in accordance with Section 09915 COLOR SCHEDULE.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Aluminum windows shall be installed in accordance with approved shop drawings and manufacturer's published instructions. Aluminum surfaces in contact with masonry, concrete, wood and dissimilar metals other than stainless steel, zinc, cadmium or small areas of white bronze, shall be protected from direct contact using protective materials recommended by AAMA 101. The completed window installation shall be watertight in accordance with Section 07920 JOINT SEALANTS. Glass and glazing shall be installed in accordance with requirements of this section and Section 08810 GLASS AND GLAZING.

### 3.2 ADJUSTMENTS AND CLEANING

#### 3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. Operating sash or ventilators shall operate smoothly and shall be weathertight when in locked position.

#### 3.2.2 Cleaning

Aluminum window finish and glass shall be cleaned on exterior and interior sides in accordance with window manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring window finish and glass surfaces.

-- End of Section --



## SECTION 08710

DOOR HARDWARE  
**02/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |            |  |
|------------|--|
| ASTM E 283 | (1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen |
| ASTM F 883 | (1990) Padlocks  |

## BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

- |              |  |
|--------------|--|
| BHMA A156.1  | (1997) Butts and Hinges (BHMA 101)                         |
| BHMA A156.2  | (1996) Bored and Preassembled Locks and Latches (BHMA 601) |
| BHMA A156.3  | (1994) Exit Devices (BHMA 701)                             |
| BHMA A156.4  | (1992) Door Controls - Closers (BHMA 301)                  |
| BHMA A156.5  | (1992) Auxiliary Locks & Associated Products (BHMA 501)    |
| BHMA A156.6  | (1994) Architectural Door Trim (BHMA 1001)                 |
| BHMA A156.7  | (1988) Template Hinge Dimensions                           |
| BHMA A156.8  | (1994) Door Controls - Overhead Holders (BHMA 311)         |
| BHMA A156.12 | (1992) Interconnected Locks & Latches (BHMA 611)           |
| BHMA A156.13 | (1994) Mortise Locks & Latches (BHMA 621)                  |
| BHMA A156.15 | (1995) Closer Holder Release Devices                       |
| BHMA A156.16 | (1997) Auxiliary Hardware                                  |
| BHMA A156.17 | (1993) Self Closing Hinges & Pivots                        |

BHMA A156.18 (1993) Materials and Finishes (BHMA 1301)  
BHMA A156.21 (1996) Thresholds  
BHMA A156.22 (1996) Door Gasketing Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1999) Fire Doors and Fire Windows  
NFPA 101 (1997) Life Safety Code

STEEL DOOR INSTITUTE (SDOI)

SDI 100 (1991) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (1999) Building Materials Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Hardware schedule; G, AE

Keying system

SD-03 Product Data

Hardware items; G, AE

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule; G, AE

SD-11 Closeout Submittals

Key bitting

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hard- ware Item	Quan- tity	Size	Reference		Mfr. Name and Catalog No.	Key Con- trol Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designa- tion
			Type	Finish				
No.			No.		No.			
-----	-----	-----	-----	-----	-----	-----	-----	-----

#### 1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

- a. Complete listing of all keys (AA1, AA2, etc.).
- b. Complete listing of all key cuts (AA1-123456, AA2-123458).
- c. Tabulation showing which key fits which door.
- d. Copy of floor plan showing doors and door numbers.
- e. Listing of 20 percent more key cuts than are presently required in each master system.

#### 1.5 QUALITY CONTROL

##### 1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified. Manufacturers and model numbers listed are to establish a standard of quality and design.

Manufacturers represented in this section are as follows:

Corbin Russwin - 800-543-3658 - [www.yalesecurity.com](http://www.yalesecurity.com)  
 Door Controls International - 800-742-3634 - [www.doorcontrols.com](http://www.doorcontrols.com)  
 Door Hardware Systems Inc. - 800-836-8085 - [www.dhsi-seal.com](http://www.dhsi-seal.com)  
 McKinney Products Co.- 800-541-1073 - [www.mckinneyhinge.com](http://www.mckinneyhinge.com)  
 Rixson Firemark, Inc. - 800-457-5670 - [www.rixsondoorcontrols.com](http://www.rixsondoorcontrols.com)  
 Trimco/BBW/Quality - 323-262-4191 - [www.trimcobbw.com](http://www.trimcobbw.com)  
 Zero International - 800-635-5335 - [www.zerointernational.com](http://www.zerointernational.com)

##### 1.5.2 Supplier Qualifications

Suppliers shall be recognized architectural finish hardware suppliers, with warehousing facilities, who have been furnishing hardware in the projects vicinity for a period of not less than 2 years and who is or employs a DHI Certified A.H.C., who is available at reasonable times during the course of the work for consultation about products hardware requirements, to owner, architect and contractor.

##### 1.5.3 Fire-Rated Openings

Fire rated openings shall be provided with fire rated hardware in

compliance with NFPA Standard No. 80 and local building code requirements. Provide only hardware tested and listed by U/L, for types and sizes of doors required and complies with requirements of door and doorframe labels.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule, door number and keyset symbol. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks. At time of delivery, inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

#### 1.7 WARRANTY

All finish hardware products shall be covered by a 1-year factory warranty against defects in material and workmanship from the date of substantial completion of the project.

Supply warranty verification to the owner for products that provide factory warranties for periods longer than one year. Locksets and exit devices shall have a 5-year factory warranty, door closers a 10-year factory warranty.

#### 1.8 MAINTENANCE

Extra Materials: Furnish 3-dozen extra screws and other fasteners of each size, type, and finish used with the hardware items provided. These screws and fasteners are to be delivered to the hardware installer for use during installation. All extra screws and fasteners and all special installation tools furnished with the hardware shall be turned over to the owner at the completion of the job.

### PART 2 PRODUCTS

#### 2.1 TEMPLATE HARDWARE

Hardware to be applied to metal or to prefinished doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

#### 2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements specified, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Such hardware shall bear the label of Underwriters Laboratories, Inc., and be listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

## 2.3 HARDWARE ITEMS

Hinges, pivots, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

### 2.3.1 Hinges

BHMA A156.1, heavy weight, 180 or 1.90 ga. five knuckle, four ball bearing, full mortise type with a stainless steel non-removable pin, 4 1/2 by 4 1/2 inches on doors up to 36 inches in width. Provide 5 inch x 4-1/2 inch hinges on doors from 28 inches to 48 inches in width.. Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90 inches or less in height and one additional hinge for each 30 inches of additional height. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Provide template units only..

Manufacturers whose products are used as the basis of design are:

Hager  
McKinney

### 2.3.2 Pivots

BHMA A156.4. Provide pivots by manufacturer of floor closers.

### 2.3.3 Locks and Latches

#### 2.3.3.1 Mortise Locks and Latches

BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with wrought steel case, 8 inches x 1-1/4 inch armor front, with e/ in ch throw, two piece stainless steel latch bolts. Furnish and install dust boxes with all strikes. Mortise trim shall have thru-bolted installation and meet the guidelines for ADA and requirements for UFAS and ANSI 1176.1, which require ease of accessibility for the handicapped and disabled. Lever trim shall have wrought or cast levers with reinforced forged roses.

Manufacturers' series which are used as the basis of design for locks are as follows:

Yale 8700 series  
Corbin-Russwin ML2000 series  
Sargent 8200 series  
Schlage L9000 series

### 2.3.4 Exit Devices

BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and

vertical rod devices. Touch bars shall be provided in lieu of conventional crossbars and arms. Furnish pull trim on all exterior and non-fire rated exit devices as indicated in the hardware sets. All nono-rated devices are to be provided with cylinder dogging. All devices are to be supplied and installed with thru-bolts. Devices are to be thru-bolted to the escutcheon trim for added strength and security. Deadbolt Exit Device: When indicated in the hardware sets, exterior doors shall be provided with a deadbolt exit device GHMA A156.3 type 28) to reduce unauthorized entry by shaking, prying or pulling with extreme force.

Manufacturers' series used as the basis of design for exit devices are as follows:

- Yale 7100 series
- Corbin-Russwin ED5000 series
- Sargent 8000 series
- Von Duprin 98 series

Manufacturers' series used as the basis of design for deadbolt exit devices are as follows:

- Yale 7150 series
- Corbin-Russwin ED5000S series
- Securitech 5841-12 series

#### 2.3.5 Exit Locks With Alarm

BHMA A156.5, Type E0431 (with full-width horizontal actuating bar) for single doors; Type E0431 (with actuating bar) or E0471 (with actuating bar and top and bottom bolts, both leaves active) for pairs of doors, unless otherwise specified. Provide terminals for connection to remote indicating panel.

#### 2.3.6 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores shall have seven pin tumblers. Cylinders shall be products of one manufacturer, and cores shall be the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets shall have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

Manufacturer series used as basis for design is as follows:

- Corbin-Russwin Pyramid 7-pin interchangeable core cylinders

#### 2.3.7 Keying System

Provide a grand master keying system an extension of the existing keying system. Provide construction interchangeable cores. Provide key cabinet as specified.

## 2.3.8 Lock Trim

Cast or heavy wrought construction.

## 2.3.8.1 Lever Handles

Provide lever handles in lieu of knobs . Lever handles for exit devices shall meet the test requirements of BHMA A156.13 for mortise locks. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in BHMA A156.13 is applied to the lever handle. Lever handles shall return to within 1/2 inch of the door face. Lever trim shall meet guidelines for ADA and requirements for UFAS and ANSI 117.1, which require ease of accessibility for the handicapped and disabled.

Manufacturer's series which are used as the basis of design for lock trim are as follows:

Yale PBR  
Corbin-Russwin PSA  
Sargent LNP  
Schlage 17B

## 2.3.9 Keys

Provide nickel silver keys only. Furnish four change keys for each lock; five control keys; 5 master keys for each master system and five grandmaster keys for each grandmaster system. Deliver all keys to the owners' representative.

Construction Keying: Provide all cylinders with temporary construction cores. The temporary construction cores are to be removed by the contractor after each section of the project is completed and replaced with the permanently keyed cores in the presence of the owner. Furnish twelve construction master keys and three removal tools and deliver to the contractor.

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## 2.3.10 Door Bolts

BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: BHMA A156.3, Type 25. Manufacturers used as basis of design are as follows:

Trimco  
DCI

## 2.3.11 Overhead Closers

BHMA A156.4, All surface closers shall be full rack and pinion type with full molded cover and shall project no more than 2 1/8" from the mounting surface. Closers shall be non handed and be provided with non gumming and non freezing hydraulic fluid. Closers shall have two valves, hex key adjusted to independently regulate closing and latch speed. Closers shall have two valves, hex key adjusted to independently regulate back check cushioning and back check position.

All closers shall have multi-size spring power adjustment to permit setting of power from size 1 through 6.

Surface closers for all exterior and high traffic openings, where floor closers are not provided, shall be provided with a combination door closer, doorstop and shock absorber. The shock absorber shall provide heavy duty springs to smoothly decelerate the door as it reaches the positive stop point.

Options: As dictated by codes or indicated in the drawings or hardware sets provide arm and feature options such as, adjustable delayed action, barrier free, positive stop and/or hold open arms, low profile arms, rigid parallel arm and special mounting brackets and plates.

All closers shall be installed on wood doors with thru-bolts.

Manufacturers' series which are used as the basis of design for overhead closers are as follows:

- Yale 4400 series
- Norton 7500 series
- Corbin-Russwin DC2200 series
- Sargent 281 series
- LCN 4041 series

Manufacturer's series which are used as the basis of design for exterior and high traffic areas are as follows:

- Yale UNI-4400 series
- Norton UNI-7500 series
- Corbin-Russwin DC2210 x A11 or A12 series
- Sargent 281 x Sargent 590 series
- LCN 4041 x GJ 90M series

#### 2.3.11.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

#### 2.3.12 Floor Closers

Floor closers shall be cast iron with a spring power adjustable helical spring, which rotates and does not move from side to side. Closers shall have separate and independent valves for adjusting closing speed, latch speed, back check, and delayed action feature. All features shall be adjustable without removing the door or threshold. Hold open feature shall be selective or as indicated in the hardware sets.

Floor closers shall have permanent, non removable spindles to assure security and total door control.

Floor closers shall have a built in dead stop and shall be installed with



overhead stop and intermediate pivots to provide complete door control and a top and bottom simultaneous cushion and dead stop. The pivots, overhead stops and thresholds are to be supplied by the floor closer manufacturer to assure proper templating and door coordination.

Exterior floor closers shall have sealed closer feature, rust proof cycolac cement case, threshold and other options as indicated in the drawings or hardware sets.

Manufacturer's series which are used as the basis of design for floor closers are as follows:

Rixson

#### 2.3.13 Coordinators

Provide non handed fully automatic coordinating devices for sequential closing of paired doors with an astragal.

Supply all coordinator accessories to eliminate problems with installing vertical rod exit devices and parallel arm closers.

All coordinators shall be provided with enough filler piece to close the header area for an architecturally clean line.

#### 2.3.14 Door Protection Plates

BHMA A156.6.

##### 2.3.14.1 Sizes of Mop and Kick Plates

All plates shall be .050 inches thick and beveled on four sides. Width for single doors shall be 2 inches less than door width; width for pairs of doors shall be one inch less than door width. Height of kick plates shall be 8 inches for flush doors and one inch less than height of bottom rail for panel doors. Height of mop plates shall be 6 inches.

#### 2.3.15 Door Stops and Silencers

Wall and Floor Stops: Supply wall stops where needed to protect doors or door hardware. When wall conditions do not permit use of wall stop provide floor stops.

Overhead Stops: Where wall or floor stops are not applicable provide surface overhead stops. Supply overhead stops/holders with extruded bronze or stainless steel channels arms and brackets. All stops shall be supplied and installed with thru bolts. Manufacturer series used as basis of design for overhead stops is as follows:

Rixson Checkmate

BHMA A156.16. Silencers Type L03011. Provide Silencers on all doorframes that do not have gasket or weather strip specified. Provide three silencers for each single door, two for each pair.

#### 2.3.16 Push Plates

Push plates shall be .050 with 3 beveled edges. Plates shall be 8" x 16", where door stiles allow, and be cut for cylinder or thumb turn as needed. Provide 4" x 16" on narrow stile doors.

#### 2.3.17 Pull Plates

Pull plates shall be .050 with four beveled edges. Plates shall be 4" x 16" and be cut for cylinder or thumb turn as needed. Pull shall be 3/4" rod at 8" centers.

#### 2.3.18 Thresholds

BHMA A156.21. Aluminum Thresholds: All thresholds shall conform to state and local handicap codes. The floor closer manufacturer shall supply floor closer thresholds.

The manufacturers used as the basis of design for thresholds are as follows:

Pemko  
National Guard Products  
Rixson (for doors with floor closers)  
Zero

#### 2.3.19 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". A set shall include head and jamb seals, sweep strips, . Air leakage of weather stripped doors shall not exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283.

Manufacturer used as basis of design for weatherstripping is as follows:

Door Hardware Systems Inc.

Manufacturer used as basis of design for exterior door sweeps is as follows:

Zero

Weather stripping shall be one of the following:

##### 2.3.19.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Aluminum shall be clear (natural) anodized.

##### 2.3.19.2 Interlocking Type

Zinc or bronze not less than 0.018 inch thick.

#### 2.3.19.3 Spring Tension Type

Spring bronze or stainless steel not less than 0.008 inch thick.

#### 2.3.20 Lightproofing and Soundproofing Gasketing

BHMA A156.22. A set shall include adjustable doorstops at head and jambs and fixed neoprene door sweep, both of extruded aluminum, clear (natural) anodized, surface applied, with neoprene seals. Doorstops at head and jamb shall have solid neoprene tube. Door sweeps shall have multiple solid neoprene fins. Doorstops shall be mitered at corners. Provide the type and function designation where specified in paragraph entitled "Hardware Sets".

Manufacturer shall show evidence that any requirements for smoke gasket can be maintained under industry allowable tolerances for warp (AWI) and plumb (SDI). Evidence shall be provided that the gasket system can meet criteria under the Field Quality Control Standards.

Manufacturer used as basis of design for sound gasketing is as follows:

Zero

#### 2.3.21 Rain Drips

Extruded aluminum, not less than 0.08 inch thick, bronze anodized. Set drips in sealant conforming to Section 07920N, "Joint Sealants," and fasten with stainless steel screws.

Manufacturer used as basis of design for sound gasketing is as follows:

Zero

##### 2.3.21.1 Door Rain Drips

Approximately 1 1/2 inches high by 5/8 inch projection. Align bottom with bottom edge of door.

##### 2.3.21.2 Overhead Rain Drips

Approximately 1 1/2 inches high by 2 1/2 inches projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

#### 2.3.22 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

#### 2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

## 2.5 FINISHES

BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which shall have aluminum paint finish, and except steel hinges which shall have BHMA 652 finish (satin chromium plated). Hinges for exterior doors shall be stainless steel with BHMA 630 finish. Exit devices may be provided in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under paragraph entitled "Hardware Sets". Exposed parts of concealed closers shall have finish to match lock and door trim. Hardware for aluminum doors shall be finished to match the doors.

## 2.6 KEY CABINET AND CONTROL SYSTEM

BHMA A156.5, Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Examine doors, frames and related items for conditions that would prevent the proper application of any finish hardware items. Do not proceed with installation until all defects are corrected.

Mount hardware units at heights indicated in "recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by the architect.

Install hardware in accordance with manufacturers' printed instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation. Wherever cutting and fitting is required to install hardware onto or into surfaces, which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division 9 sections. Do not install surface mounted items until finishes have been completed on the substrate.

Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

Drill and countersink units, which are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

Set thresholds for exterior doors in full bed of butyl rubber or polyisobutylene mastic sealant.

### 3.1.1 Weather Stripping Installation

Handle and install weather stripping so as to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

#### 3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inches o.c. after doors and frames have been finish painted.

#### 3.1.1.2 Interlocking Type Weather Stripping

Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills. Nail weather stripping to door one inch o.c. and to heads and jambs at 4 inches o.c.

#### 3.1.1.3 Spring Tension Type Weather Stripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze, stainless steel nails with stainless steel. Space nails not more than 1 1/2 inches o.c.

### 3.1.2 Soundproofing Installation

Install as specified for stop-applied weather stripping. No light of day shall be visible at door bottom, jambs, or head at doors with sound seals.

### 3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

## 3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors .

## 3.3 HARDWARE LOCATIONS

SDI 100, unless indicated or specified otherwise.

- a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.
- b. Mop Plates: Bottom flush with bottom of door.

## 3.4 KEY CABINET AND CONTROL SYSTEM

Locate where directed . Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key.

Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand

master key.

### 3.5 FIELD QUALITY CONTROL

To ensure and validate the proper closing, latching, sealing and securing of a door the manufacturer of gasketing shall provide a program of Field Quality Assurance. The program shall be acceptable to the architect and provide the site superintendent and installers with knowledge as to the industry acceptable standards for tolerances in manufacturing and field installation. The program shall create an audit trail of documentation for the inspection of pre-machined doors for machining and sizing, including hinge backset and depth of mortise, width and height. An "Installation Checklist" guideline shall also be furnished for verification of acceptability of related door, frame and hardware components prior to installing gasketing. These forms shall be part of the submittal process and shall be acknowledged by the site supervisor and returned to the manufacturer on a timely basis. After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

Final adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

Instruct owner's personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

Continued Maintenance: Approximately six months after the acceptance of hardware in each area, the installer, accompanied by the contractor, shall return to the project and re adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items, which have deteriorated or failed due to faulty materials or installation of hardware units. Prepare a written report of current and predictable problems in the performance of the hardware.

## 3.6 HARDWARE SETS

#	req'd.	item	part number	finish	mfr.
HW-1 (DOORS 100A, 100B, 100C, 108A, 108C, 119A, 119B, 119C)					
2	EA.	FLOOR CLOSERS	SC2790-NHO-LFP	613	RIX
4	EA.	INTERMEDIATE PIVOTS	M19 (C07321)	613	RIX
1	SET	AUTO FLUSH BOLTS	962	613	DCI
1	EA.	COORDINATOR	656-ACT36 (TYPE 21A)	BLK	DCI
1	EA.	EXIT DEVICE-MORTISE	ED5600-T13M57-M52 (TYPE 3-02)	613	C/R
2	EA.	MORTISE CYLINDERS	1030-114-A01-CTP	613	C/R
3	EA.	CORES	8027	613	C/R
2	EA.	KICK PLATE	KO050-8" (J102)	613	TRI
1	EA.	THRESHOLD	#3-800 (J19100)	613	RIX
2	EA.	DOOR SWEEPS	#8198D (R3A535)		ZER
1	SET	WEATHERSTRIP	#105	DB	DHS
1	EA.	ASTRAGAL	BY DOOR MFG		
HW-2 (DOOR 001)					
6	EA.	HINGES	T4A3386-NRP (A2111)	613	MCK
2	EA.	FLUSH BOLTS	790F (L14261)	613	DCI
1	EA.	STOREROOM LOCKSET	ML2057-PSA-CTP (F07)	613	C/R
1	EA.	CORE	8027	613	C/R
1	EA.	CLOSER STOP	DC2210-A11 (C02021-PT4D,G,H)	690	C/R
2	EA.	KICK PLATE	KO050-8" (J102)	613	TRI
1	EA.	OVERHEAD STOP	10-136 (C05541)	613	RIX
1	EA.	THRESHOLD	#566B	613	ZER
2	EA.	DOOR SWEEPS	#8198D (R3A535)		ZER
1	SET	WEATHERSTRIP	#105	DB	DHS
1	EA.	ASTRAGAL	BY DOOR MFG		
HW-3 (DOORS 110, 118A)					
3	EA.	HINGES	T4A3386-NRP (A2111)	613	MCK
1	EA.	DEADBOLT EXIT DEVICE	ED5200S-T1357-M52 (TYPE 28-02)	613	C/R
1	EA.	RIM CYLINDER	3030-178-CTP	613	C/R
1	EA.	MORTISE CYLINDER	1030-114-A01-CTP	613	C/R
2	EA.	CORES	8027	613	C/R
1	EA.	CLOSER STOP	DC2210-A11 (C02021-PT4D,G,H)	690	C/R
1	EA.	KICK PLATE	KO050-8" (J102)	613	TRI
1	EA.	THRESHOLD	#545B (J12150)	613	ZER
1	EA.	DOOR SWEEP	#8198D (R3A535)		ZER
1	SET	WEATHERSTRIP	#105	DB	DHS
1	EA.	RAIN DRIP	#142D		ZER

## HW-4 (DOOR 113)

3 EA.	HINGES	T4A3386-NRP (A2111)	613	MCK
1 EA.	STOREROOM LOCKSET	ML2057-PSA-CTP (F07)	613	C/R
1 EA.	CORE	8027	613	C/R
1 EA.	CLOSER STOP	DC2210-A11 (C02021-PT4D,G,H)	690	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	613	TRI
1 EA.	THRESHOLD	#566B	613	ZER
1 EA.	DOOR SWEEP	#8198D (R3A535)		ZER
1 SET	WEATHERSTRIP	#105	DB	DHS
1 EA.	RAIN DRIP	#142D		ZER

## HW-5 (DOOR 111A)

3 EA.	HINGES	T4A3386-NRP (A2111)	613	MCK
1 EA.	CLASSROOM LOCKSET	ML2055-PSA-CTP (F05)	613	C/R
1 EA.	CORE	8027	613	C/R
1 EA.	CLOSER STOP	DC2210-A11 (C02021-PT4D,G,H)	690	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	613	TRI
1 EA.	THRESHOLD	#545B (J12150)	613	ZER
1 EA.	DOOR SWEEP	#8198D (R3A535)		ZER
1 SET	WEATHERSTRIP	#105	DB	DHS

## HW-6 (DOORS 116A, 116B)

3 EA.	HINGES	T4A3786 (A8111)	652	MCK
1 EA.	DEADBOLT EXIT DEVICE	ED5200S-T1357-M52 (TYPE 28-02)	613	C/R
1 EA.	RIM CYLINDER	3030-178-CTP	613	C/R
1 EA.	MORTISE CYLINDER	1030-114-A01-CTP	613	C/R
2 EA.	CORES	8027	613	C/R
1 EA.	CLOSER STOP	DC2210-A11 (C02021-PT4D,G,H)	690	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	613	TRI
1 SET	WEATHERSTRIP	#105	DB	DHS
BALANCE OF HARDWARE		BY SLIDING DOOR MFG		

## HW-7 (DOORS 124, 125, 126, 127, 128, 132)

3 EA.	HINGES	T4A3786 (A8111)	652	MCK
1 EA.	ALARMED EXIT DEVICE-RIM	ED5200-PR910-M61 (TYPE 1-14 alarmed)	630	C/R
1 EA.	MORTISE CYLINDER	1030-114-A01-CTP	626	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	CLOSER STOP	DC2210-A11 (C02021-PT4D,G,H)	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	THRESHOLD	#545A (J12150)		ZER
1 EA.	DOOR BOTTOM	253A		ZER
1 SET	SOUND SEAL	870A	DB	ZER



## HW-8 (DOORS 129, 130, 131, 133, 134)

3 EA.	HINGES	T4A3786 (A8111)	652	MCK
1 EA.	EXIT DEVICE-RIM	ED5200-PR910 (TYPE 1-14)	630	C/R
1 EA.	MORTISE CYLINDER	1030-114-A01-CTP	626	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	CLOSER STOP	DC2210-A11 (C02021-PT4D,G,H)	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	THRESHOLD	#545A (J12150)		ZER
1 EA.	DOOR BOTTOM	253A		ZER
1 SET	SOUND SEAL	870A	DB	ZER

## HW-9 (DOORS 101, 123)

3 EA.	HINGES	T4A3786-NRP (A8111)	652	MCK
1 EA.	DEADBOLT EXIT DEVICE	ED5200S-PR955 (TYPE 1-08)	630	C/R
1 EA.	MORTISE CYLINDER	1030-114-A01-CTP	626	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	CLOSER	DC2210 (C02021-PT4D,H)	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	WALLSTOP	3210 (L02251)	630	DCI
1 EA.	DOOR BOTTOM	253A		ZER
1 SET	SOUND SEAL	870A	DB	ZER

## HW-10 (DOOR 108B)

3 EA.	HINGES	T4A3786 (A8111)	652	MCK
1 EA.	EXIT DEVICE-RIM	ED5200-PR910 (TYPE1-14)	630	C/R
1 EA.	CLOSER	DC2210 (C02021-PT4D,H)	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	WALLSTOP	3210 (L02251)	630	DCI

## HW-11 (DOORS 002, 105, 115)

3 EA.	HINGES	T4A3786 (A8111)	652	MCK
1 EA.	STOREROOM LOCKSET	ML2057-PSA-CTP (F07)	630	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	CLOSER	DC2200 (C02011-PT4D,H)	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	FLOORSTOP	3310 (L02141)	626	DCI
1 EA.	THRESHOLD	#545A (J12150)		ZER
1 EA.	DOOR BOTTOM	253A		ZER
1 SET	DOOR SEAL	870A	DB	ZER

## HW-12 (DOOR 106)

3 EA.	HINGES	T4A3786-NRP (A8111)	652	MCK
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1 EA.	STOREROOM LOCKSET	ML2057-PSA-CTP (F07)	630	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	CLOSER	DC2210 (C02021-PT4D,H)	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	WALLSTOP	3210 (L02251)	630	DCI
1 EA.	THRESHOLD	#545A (J12150)		ZER
1 EA.	DOOR BOTTOM	253A		ZER
1 SET	DOOR SEAL	870A	DB	ZER

## HW-13 (DOORS 111B, 118B)

3 EA.	HINGES	T4A3786 (A8111)	652	MCK
1 EA.	CLASSROOM LOCKSET	ML2055-PSA-CTP (F05)	630	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	CLOSER	DC2200 (C02011-PT4D,H)	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	FLOORSTOP	3310 (L02141)	626	DCI
1 EA.	THRESHOLD	#545A (J12150)		ZER
1 EA.	DOOR BOTTOM	253A		ZER
1 SET	DOOR SEAL	870A	DB	ZER

## HW-14 (DOORS 107, 109, 112)

3 EA.	HINGES	T4A3786-NRP (A8111)	652	MCK
1 EA.	OFFICE LOCKSET	ML2065-PSA-CTP (F13)	630	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	CLOSER	DC2200 (C02011-PT4D,H)	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	WALLSTOP	3210 (L02251)	630	DCI

## HW-15 (DOORS 103, 114, 117, 121)

3 EA.	HINGES	T4A3386 (A5111)	630	MCK
1 EA.	PRIVACY	ML2020-PSA (F02)	630	C/R
1 EA.	CLOSER	DC2200 (C02011-PT4D,H)	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	MOP PLATE	KM050-6" (J103)	630	TRI
1 EA.	FLOORSTOP	3310 (L02141)	626	DCI

## HW-16 (DOORS 104, 120)

3 EA.	HINGES	T4A3386 (A5111)	630	MCK
1 EA.	DEADLOCK	ML2017-CTP (F17-classroom)	626	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	PUSH PLATE	1001-3 (J304)	630	TRI
1 EA.	PULL PLATE	1017-3B (J405)	630	TRI
1 EA.	CLOSER	DC2200 (C02011-PT4D,H)	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	MOP PLATE	KM050-6" (J103)	630	TRI

## HW-17 (DOORS 118C, 118D)

6 EA.	HINGES	TA2714 (A8112)	652	MCK
2 EA.	DUMMY PULLS	ML2050-PSA	630	C/R
2 EA.	ROLLER CATCHES	(L07091)	628	
1 EA.	WALLSTOP	3210 (L02251)	630	DCI
1 EA.	ROLLER STOP	1245 (L02211)	626	TRI

## HW-18 (DOOR 119D)

3 EA.	HINGES	T4A3786-NRP (A8111)	652	MCK
1 EA.	STOREROOM LOCKSET	ML2057-PSA-CTP (F07)	630	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	CLOSER	DC2210 ((C02021-PT4D,H))	689	C/R
1 EA.	KICK PLATE	KO050-8" (J102)	630	TRI
1 EA.	WALLSTOP	3210 (L02251)	630	DCI
1 SET	DOOR SEAL	870A	DB	ZER

## HW-19 (DOORS 201A, 201B, 202)

3 EA.	HINGES	T4A3786-NRP (A8111)	652	MCK
1 EA.	STOREROOM LOCKSET	ML2057-PSA-CTP (F07)	630	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	FLOORSTOP	3310 (L02141)	626	DCI
1 EA.	DOOR BOTTOM	253A		ZER
1 SET	DOOR SEAL	870A	DB	ZER

## HW-20 (DOOR 122)

3 EA.	HINGES	T4A3786-NRP (A8111)	652	MCK
1 EA.	STOREROOM LOCKSET	ML2057-PSA-CTP (F07)	630	C/R
1 EA.	CORE	8027	626	C/R
1 EA.	FLOORSTOP	3310 (L02141)	626	DCI

-- End of Section --

## SECTION 08800

GLAZING  
10/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; R 1994) Safety Glazing Materials  
Used in Buildings

## AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2000) Minimum Design Loads for Buildings  
and Other Structures ++

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509 (2000) Elastomeric Cellular Preformed  
Gasket and Sealing Material

ASTM C 669 (2000) Glazing Compounds for Back Bedding  
and Face Glazing of Metal Sash

ASTM C 864 (1999) Dense Elastomeric Compression Seal  
Gaskets, Setting Blocks, and Spacers

ASTM C 920 (2002) Elastomeric Joint Sealants

ASTM C 1036 (2001) Flat Glass

ASTM C 1048 (1997; Rev. B) Heat-Treated Flat Glass -  
Kind HS, Kind FT Coated and Uncoated Glass

ASTM C 1172 (1996e1) Laminated Architectural Flat Glass

ASTM C 1184 (2000; Rev. A) Structural Silicone Sealants

ASTM D 395 (2001) Rubber Property - Compression Set

ASTM D 673 (1993ael) Mar Resistance of Plastics

ASTM D 4802 (2002) Poly(Methyl Methacrylate) Acrylic  
Plastic Sheet

ASTM E 119 (2000a) Fire Tests of Building

## Construction and Materials

ASTM E 773	(2001) Accelerated Weathering of Sealed Insulating Glass Units
ASTM E 774	(1997) Sealed Insulating Glass Units
ASTM E 1300	(2000) Determining Load Resistance of Glass in Buildings
ASTM E 2010	(2001) Positive Pressure Fire Tests of Window Assemblies

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201	Architectural Glazing Materials
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## GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(1997) Glazing Manual
GANA Sealant Manual	(1990) Sealant Manual
GANA Standards Manual	(2001) Tempering Division's Engineering Standards Manual

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows
NFPA 252	(1999) Fire Tests of Door Assemblies
NFPA 257	(2000) Fire Tests for Window and Glass Block Assemblies

## THE INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

SIGMA A1202	(1983) Commercial Insulating Glass Dimensional Tolerances
SIGMA TM-3000	(1997) Glazing Guidelines for Sealed Insulating Glass Units
SIGMA TB-3001	(1990) Sloped Glazing

## UNDERWRITERS LABORATORIES (UL)

UL ABPMED	(2000) Automotive Burglary Protection and Mechanical Equipment Directory
UL 752	(2000) Bullet-Resisting Equipment

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

InstallationG, AE

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

### SD-03 Product Data

Insulating Glass

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

### SD-04 Samples

Spandrel Glass; G, AE

Insulating Glass

Glazing Compound

Glazing Tape

Sealant

Two 8 x 10 inch samples of each of the following: insulating glass units.

### SD-07 Certificates

Insulating Glass

### SD-08 Manufacturer's Instructions

Setting and sealing materials

Glass setting

Submit glass manufacturer's recommendations for setting and

sealing materials and for installation of each type of glazing material specified.

### 1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

### 1.5 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

### 1.6 WARRANTY

#### 1.6.1 Warranty for Insulating Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 5-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government.

## PART 2 PRODUCTS

### 2.1 GLASS

ASTM C 1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

#### 2.1.1 Annealed Glass

Annealed glass shall be Type I transparent flat type, Class 1 - clear, Quality q3 - glazing select, 75 percent light transmittance.

### 2.1.2 Laminated Glass

ASTM C 1172, Kind LA fabricated from two nominal 1/8 inch pieces of Type I, Class 1, Quality q3, flat annealed transparent glass conforming to ASTM C 1036. Flat glass shall be laminated together with a minimum of 0.030 inch thick, clear polyvinyl butyral interlayer. The total thickness shall be nominally 1/4 inch. Where required in description of insulated glass units, one ply shall be low-e coated glass, as described below under Low-E Coated Glass.

### 2.1.3 Tempered Glass

ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (transparent), Quality q3, 1/4 inch thick, 75 percent light transmittance. Provide wherever safety glazing material is indicated or specified.

### 2.1.4 Low-E Coated Glass

Low-E coated glass shall be Type I transparent flat annealed type, Class 1 - clear, Quality z3, 1/8 inch thick, with low-e pyrolitic coating. Low-e glass shall have 61% visible light transmittance, 10% outdoor visible light reflectance, 0.52 solar heat gain coefficient, and 0.61 shading coefficient.

### 2.1.5 Spandrel Glass

#### 2.1.5.1 Ceramic-Opacified Spandrel Glass

Ceramic-opacified spandrel glass shall be Kind HS heat-strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 2 surface, Quality q3 - glazing select, 1/4 inch thick, conforming to ASTM C 1048. Color shall be as selected by architect from manufacturer's full color range..

## 2.2 INSULATING GLASS UNITS

Two panes of glass separated by a dehydrated airspace and hermetically sealed. Dimensional tolerances shall be as specified in SIGMA A1202. The units shall conform to ASTM E 773 and ASTM E 774, Class A. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

### 2.2.1 Low-E (Low-Emissivity) Insulating Glass Units

Provide 1/2 inch airspace. The inner lite shall be laminated glass as described above under Laminated Glass.. The outer lite shall be laminated glass as described above under Laminated Glass, with low-e coating on one laminated glass ply. Low-e coating shall be as described above under Low-E Coated Glass, on second surface of insulating glass unit. Glass performance shall be R-Value/Winter Nighttime 2.94.



### 2.2.2 Ceramic-Opacified Spandrel Insulating Glass

Provide 1/2 inch airspace. The inner lite shall be ceramic-opacified spandrel glass as described above under Ceramic-Opacified Spandrel Glass. The outer lite shall be laminated glass as described above under Laminated Glass.

## 2.3 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, SIGMA TM-3000, SIGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

### 2.3.1 Sealants

Provide elastomeric sealants.

#### 2.3.1.1 Elastomeric Sealant

ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units. Color of sealant shall be as selected.

### 2.3.2 Sealing Tapes

Preformed, semisolid, polymeric-based material of proper size and compressibility for the particular condition. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

### 2.3.3 Setting Blocks and Edge Blocks

Neoprene setting blocks shall be dense extruded type conforming to ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer.

### 2.3.4 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners.

Glazing gasket profiles shall be as indicated on drawings.

#### 2.3.4.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

#### 2.3.4.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

#### 2.3.4.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

#### 2.3.5 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

### ]PART 3 EXECUTION

#### 3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, SIGMA TB-3001, SIGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

#### 3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, SIGMA TB-3001, SIGMA TM-3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place.

### 3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

### 3.2.2 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of SIGMA TB-3001 and SIGMA TM-3000.

### 3.2.3 Installation of Laminated Glass

Sashes which are to receive laminated glass shall be weeped to the outside to allow water drainage into the channel.

## 3.3 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted.

## 3.4 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

-- End of Section --

## SECTION 09100N

## METAL SUPPORT ASSEMBLIES

09/99

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 463/A 463M	(1997; Rev. A) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 645	(1998) Nonstructural Steel Framing Members
ASTM C 754	(1997) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 841	(1997) Installation of Interior Lathing and Furring

## METAL LATH/STEEL FRAMING ASSOCIATION (ML/SFA)

NAAMM ML/SFA MLF	(1991) Metal Lathing and Furring
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## UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1997) Fire Resistance Directory
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## 1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

## SD-02 Shop Drawings

Metal support systems; G; AE

Submit for the erection of metal acoustical barrier ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

## SD-03 Product Data; G; AE

## Combination Neoprene Element and Spring Hanger

## Resilient Sound Isolation Clips

## 1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

## PART 2 PRODUCTS

## 2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating ASTM A 653/A 653M, G-60; aluminum coating ASTM A 463/A 463M, T1-25; or a 55-percent aluminum-zinc coating.

## 2.1.1 Materials for Attachment of Gypsum Wallboard

## 2.1.1.1 Suspended and Furred Ceiling Systems

ASTM C 645.

## 2.1.1.2 Suspended Acoustical Barrier Ceiling Systems

Combination Neoprene Element and Spring Hanger: Hanger consisting of a steel frame containing a neoprene isolation element at the top and a coil steel spring sheathed in a neoprene cup on the bottom. Both the element and the cup shall be molded with a neoprene bushing that passes through the steel frame. Hangers shall be selected for a minimum of 0.75 inch spring deflection and factory precompressed 70% of the total deflection determined by the assigned load. Hangers shall be manufactured with provision for bolting or attaching to the ceiling with flat iron straps, wire, rods or steel runners. Hangers shall be fail safe.

## 2.1.1.3 Nonload-Bearing Wall Framing and Furring

ASTM C 645, but not thinner than 0.0179 inch thickness, with 0.0329 inch minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures 0.0329 inch thickness.

## 2.1.1.4 Sound Isolating Furring

Resilient Sound Isolation Clip: Assembly consisting of a clip shaped to engage 7/8 inch steel furring channel, a ferrule to receive a fastener to attach assembly to substrate, a rubber isolating pad between ferrule and clip, and a rubber pedestal isolating the clip and the substrate.

Clip: galvanized or aluminum-zinc coated 16 gauge steel clip, shaped to engage 7/8 inch cold-formed galvanized steel furring

channel.

Ferrule: zinc-electroplated steel.

Rubber Isolator: molded natural organic rubber compound blended with fire-inhibiting compounds.

Projection: 1-5/8 inches from supporting structure, when 7/8 inch drywall furring channels are used.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Systems for Attachment of Gypsum Wallboard

###### 3.1.1.1 Suspended and Furred Ceiling Systems

ASTM C 754, except that framing members shall be 16 inches o.c. unless indicated otherwise.

###### 3.1.1.2 Suspended Acoustical Barrier Ceiling Systems

Lay out ceiling support wires per manufacturer's instructions. Connect wires to lower end of hangers and proceed with steel ceiling grid construction in the manner of regular suspended and furred ceiling system.

Attach the first layer of gypsum board to the ceiling steel, covering the upper surface of the gypsum board with 6" sound attenuation batts as completely as possible.

Attach the second layer of gypsum board, staggering joints in both directions, and according to instructions for 2-layer gypsum board application in Section 09250 GYPSUM BOARD.

Continue hanger wires to acoustical ceiling, caulking all hanger wire penetrations where they pass through the gypsum ceiling.

To support mechanical equipment, pipes or ducts below the barrier ceiling, provide additional hangers not connected to or supporting barrier ceiling and sponge sleeves where these rods pass through the barrier ceiling. Caulk perimeter of all sleeves.

At contractor's option, a low profile ceiling isolation hanger allowing support of 1-1/2 inch channel suspension members adjacent to spring housing by means of a receiver arm may be used. Assembly must provide same configuration of spring with neoprene isolation elements at top and bottom.

Low profile assembly permits suspension of mechanical elements from same hangers carrying barrier ceiling.

###### 3.1.1.3 Nonload-Bearing Wall Framing and Furring

ASTM C 754, except as indicated otherwise.

## 3.1.1.4 Sound Isolating Furring

Install resilient sound isolation clips and drywall furring channels in accordance with manufacturer's instructions, spaced as indicated on drawings.. Mechanically fasten resilient sound isolation clips to structure.

Locate splices in drywall furring channels between sound isolation clips.

Install typosum board in vertical or horizontal position with 1/8- to 1/4-inch gap around perimeter for acoustical sealant application.

## 3.2 ERECTION TOLERANCES

Framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:

- a. Layout of walls and partitions: 1/4 inch from intended position;
- b. Plates and runners: 1/4 inch in 8 feet from a straight line;
- c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and
- d. Face of framing members: 1/4 inch in 8 feet from a true plane.

Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

- a. Layout of walls and partitions: 1/4 inch from intended position;
- b. Plates and runners: 1/8 inch in 8 feet from a straight line;
- c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and
- d. Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

## SECTION 09250

GYPSUM BOARD  
11/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11 (1992) Interior Installation of  
Cementitious Backer Units

ANSI A108.1 (1992) Cementitious Backer Units

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 36/C 36M (1999) Gypsum Wallboard

ASTM C 79/C 79M (2001) Standard Specification for Treated  
Core and Nontreated Core Gypsum Sheathing  
Board

ASTM C 442/C 442M (1999; Rev. A) Gypsum Backing Board and  
Coreboard

ASTM C 475 (1994) Joint Compound and Joint Tape for  
Finishing Gypsum Board

ASTM C 514 (1996) Nails for the Application of Gypsum  
Board

ASTM C 557 (1999) Adhesives for Fastening Gypsum  
Wallboard to Wood Framing

ASTM C 630/C 630M (2001) Water-Resistant Gypsum Backing Board

ASTM C 840 (2001) Application and Finishing of Gypsum  
Board

ASTM C 954 (2000) Steel Drill Screws for the  
Application of Gypsum Board or Metal  
Plaster Bases to Steel Studs from 0.033  
in. (0.84 mm) to 0.112 in. (2.84 mm) in  
Thickness

ASTM C 960/C 960M (1997) Predecorated Gypsum Board



ASTM C 1002	(2000) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases
ASTM C 1047	(1999) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1177/C 1177M	(1999) Standard Specification for Glass Mat Gypsum Substrate for use as Sheathing
ASTM C 1178/C 1178M	(1999) Glass Mat Water-Resistant Gypsum Backing Board
ASTM C 1396/C 1396M	(2000) Standard Specification for Gypsum Board
ASTM D 226	(1997) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 412	(1998) Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension
ASTM D 624	(2000) Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1037	(1999) Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D 1149	(1999) Standard Test Method for Rubber Deterioration-Surface Ozone Cracking in a Chamber
ASTM D 2394	(1999) Standard Method for Simulated Service Testing of Wood and Wood-Base Finish Flooring
ASTM D 5420	(1998) Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 695	(1997) Standard Method for Measure Relative Resistance of Wall, Floor and Roof Construction to Impact Loads

GYPSUM ASSOCIATION (GA)

GA 214	(1996) Recommended Levels of Gypsum Board Finish
GA 216	(2000) Application and Finishing of Gypsum Board
GA 224	(1997) Installation of Predecorated Gypsum Board
GA 253	(1999) Application of Gypsum Sheathing
GA 600	(2000) Fire Resistance and Sound Control Design Manual

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(2000) Fire Resistance Directory
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1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Glass Mat Water-Resistant Gypsum Tile Backing Board

Water-Resistant Gypsum Backing Board

Accessories

Submit for each type of gypsum board and for cementitious backer units.

SD-07 Certificates

Asbestos Free Materials

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

### 1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

### 1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

## 1.4 ENVIRONMENTAL CONDITIONS

### 1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

### 1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

## 1.5 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Conform to specifications, standards and requirements specified herein. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

#### 2.1.1 Gypsum Board

ASTM C 36/C 36M and ASTM C 1396/C 1396M.

##### 2.1.1.1 Regular

48 inches wide, 5/8 inch thick, tapered edges.

2.1.1.2 Type X (Special Fire-Resistant)

48 inches wide, 5/8 inch thick, tapered edges.

2.1.2 Gypsum Backing Board

ASTM C 442/C 442M, gypsum backing board shall be used as a base in a multilayer system.

2.1.2.1 Regular

48 inches wide, 5/8 inch thick, square edges.

2.1.2.2 Type X (Special Fire-Resistant)

48 inches wide, 5/8 inch thick, square edges.

2.1.3 Regular Water-Resistant Gypsum Backing Board

ASTM C 630/C 630M

2.1.3.1 Regular

48 inches wide, 5/8 inch thick, tapered edges.

2.1.3.2 Type X (Special Fire-Resistant)

48 inches wide, 5/8 inch thick, tapered edges.

2.1.4 Glass Mat Water-Resistant Gypsum Tile Backing Board

ASTM C 1178/C 1178M

2.1.4.1 Regular

48 inches wide, 5/8 inch thick, square edges.

2.1.4.2 Type X (Special Fire-Resistant)

48 inches wide, 5/8 inch thick, square edges.

2.1.5 Joint Treatment Materials

ASTM C 475.

2.1.5.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.5.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

## 2.1.5.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

## 2.1.5.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

## 2.1.5.5 Joint Tape

Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

## 2.1.6 Fasteners

## 2.1.6.1 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

## 2.1.6.2 Staples

No. 16 USS gage flattened galvanized wire staples with 7/16 inch wide crown outside measurement and divergent point for base ply of two-ply gypsum board application. Use as follows:

<u>Length of Legs (inch)</u>	<u>Thickness of Gypsum Board (inch)</u>
1 1/8	1/2
1 1/4	5/8

## 2.1.7 Adhesives

Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene.

## 2.1.7.1 Adhesive for Fastening Gypsum Board to Metal Framing

Type recommended by gypsum board manufacturer.

## 2.1.7.2 Adhesive for Laminating

For laminating two-ply gypsum board systems , provide adhesive recommended by gypsum board manufacturer.

## 2.1.8 Accessories

ASTM C 1047. Fabricate from corrosion protected steel. Use of non-taping trim pieces designed to be exposed shall not be permitted. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free

of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide trim accessories designed for taping and finishing.

#### 2.1.8.1 Interior Trim Shapes

Cornerbead: Use at outside corners.

LC-Bead: Use at expose panel edges (requires taping and finishing).

Expansion (control) joint: Use at gypsum board partitions spanning building expansion joints.

Z Reveal Molding: Use where indicated.

#### 2.1.9 F3 Industrial Felt

For use at nested track assemblies, high density industrial felt with 90% minimum wool content, 1/4 inch thick, meeting the following specifications:

- a. SAE F3, Federal C-F-2006
- b. 16R3 Navy 27 F7e-F3

#### 2.1.10 Water

Clean, fresh, and potable.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

##### 3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

##### 3.1.2 Gypsum Board and Framing

Verify that surfaces of gypsum board and framing to be bonded with an adhesive are free of dust, dirt, grease, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

#### 3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified herein. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length. Cut out gypsum board as required to make neat close joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach

full height of vertical surfaces in one continuous piece. Surfaces of gypsum board and substrate members may be bonded together with an adhesive, except where prohibited by fire rating(s). Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

#### 3.2.1 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C 840, System VIII or GA 216.

#### 3.2.2 Arches and Bending Radii

Apply gypsum board in accordance with ASTM C 840, System IX or GA 216.

#### 3.2.3 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas (areas other than tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply glass matt water-resistant gypsum tile backing board or water-resistant gypsum backing board in accordance with ASTM C 840, System X or GA 216.

#### 3.2.4 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with ASTM C 840, System XIII or GA 216, unless indicated otherwise. Control joints between studs in fire-rated construction shall be filled with firesafing insulation to match the fire-rating of construction.

#### 3.2.5 Perimeter Isolation

Isolate perimeter of non-load bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations, and trim edges with LC-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant and backer rod.

### 3.3 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216. Plenum areas above ceilings shall be finished to Level 1 in accordance with GA 214. Water resistant gypsum backing board, ASTM C 630/C 630M, to receive ceramic tile shall be finished to Level 2 in accordance with GA 214. Walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting shall be finished to Level 3 in accordance with GA 214. Walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings shall be finished to Level 4 in accordance with GA 214. Unless otherwise specified, all gypsum board walls, partitions and ceilings shall be finished to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum

board manufacturer.

#### 3.3.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

#### 3.4 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07920 JOINT SEALANTS. Seal penetrations at acoustically-significant construction as specified in Section 07920 JOINT SEALANTS and as indicated in drawings. Apply material with exposed surface flush with gypsum board or cementitious backer units.

#### 3.5 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall and ceiling framing in accordance with the specifications contained in UL Fire Resist Dir for the Design Number(s) indicated, . Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements. Penetrations through rated partitions and ceilings shall be sealed tight in accordance with tested systems. Fire ratings shall be as indicated.

#### 3.6 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finish as specified.

-- End of Section --



## SECTION 09310

CERAMIC TILE, QUARRY TILE, AND PAVER TILE  
8/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |             |  |
|-------------|--|
| ANSI A108.1 | (1999) Installation of Ceramic Tile;<br>including A108.1A-C, 108.4-.13, 118.1-.10,<br>A136.1 |
| ANSI A137.1 | (1988) Ceramic Tile  |

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |            |  |
|------------|--|
| ASTM A 185 | (1997) Steel Welded Wire Fabric, Plain,<br>for Concrete Reinforcement  |
| ASTM C 33  | (1999a) Concrete Aggregates  |
| ASTM C 144 | (1999) Aggregate for Masonry Mortar  |
| ASTM C 150 | (1999a) Portland Cement  |
| ASTM C 206 | (1984; R 1997) Finishing Hydrated Lime   |
| ASTM C 207 | (1991; R 1997) Hydrated Lime for Masonry<br>Purposes   |
| ASTM C 241 | (1997) Abrasion Resistance of Stone<br>Subjected to Foot Traffic   |
| ASTM C 373 | (1988; R 1994) Water Absorption, Bulk<br>Density, Apparent Porosity, and Apparent<br>Specific Gravity of Fired Whiteware<br>Products |
| ASTM C 482 | (1981; R 1996) Bond Strength of Ceramic<br>Tile to Portland Cement   |
| ASTM C 501 | (1984; R 1996) Relative Resistance to Wear<br>of Unglazed Ceramic Tile by the Taber<br>Abraser                                       |

ASTM C 648	(1998) Breaking Strength of Ceramic Tile
ASTM C 847	(1995) Metal Lath
ASTM C 1026	(1987; R 1996) Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(1999) Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(1996) Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
ASTM C 1178/C 1178M	(1999) Glass Mat Water-Resistant Gypsum Backing Panel
ASTM F 446	(1985; R 1993) Grab Bars and Accessories Installed in Bathing Area

## MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual	(1991) Design Manual IV Dimensional Stone
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 99	(1999) Health Care Facilities
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## TILE COUNCIL OF AMERICA (TCA)

TCA Hdbk	(1997) Handbook for Ceramic Tile Installation
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## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Tile; G, AE  
Setting-Bed; G, AE

Mortar, Grout, and Adhesive; G, AE

Manufacturer's catalog data and preprinted installation and cleaning instructions.

SD-04 Samples

Tile; G, AE

Accessories; G, AE

Slate Thresholds; G, AE

Samples of sufficient size to show color range, pattern, type and joints.

SD-07 Certificates

Tile

Mortar, Grout, and Adhesive

Certificates indicating conformance with specified requirements. A master grade certificate shall be furnished for tile.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover in accordance with manufacturer's instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

Ceramic tile work shall not be performed unless the substrate and ambient temperature is at least 50 degrees F and rising. Temperature shall be maintained above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used they shall be vented to the outside to avoid carbon dioxide damage to new tilework.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

1.6 EXTRA STOCK

Supply an extra two percent of each type tile used in clean and marked cartons.

## PART 2 PRODUCTS

## 2.1 TILE

Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 90 lbs and 350 lbs for floor tile in accordance with ASTM C 648. Tile for cold climate projects shall be rated frost resistant by the manufacturer as determined by ASTM C 1026. Water absorption for floor tile shall be .06 maximum percent in accordance with ASTM C 373. Water absorption for wall tile shall be less than 20 percent. Floor tile shall have a minimum coefficient of friction of 0.60 wet and dry in accordance with ASTM C 1028. Floor tile shall have a minimum rating of 270 minutes in accordance with ASTM C 501. Color shall be in accordance with Section 09915 COLOR SCHEDULE .

## 2.1.1 Porcelain Paver Tile

Porcelain tile and trim shall be unglazed with the color extending uniformly through the body of the tile. Tile size shall be nominal 6 by 6 inches by 5/16 inch thick. Tile shall meet or exceed the following criteria: Abrasive wear in accordance with ASTM C 501 and bonding strength in accordance with ASTM C 482: 250 minutes. Tile shall comply with 36 CFR 1191 for coefficient of friction for interior floors. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

## 2.1.2 Glazed Wall Tile A

Glazed wall tile and trim shall be cushion edged with gloss glaze. Tile shall be nominal 3 x 6 x 5/16 inches. Color shall be in accordance with Section 09915 COLOR SCHEDULE .

Trim units shall include the following:

Wainscot cap: surface bullnose, module size 3 x 6 inches.

External corners: surface bullnose, module size 3 x 6 inches.

## 2.1.3 Glazed Wall Tile B

Glazed wall tile and trim shall be cushion edged with semi-gloss glaze. Tile shall be nominal 3 x 6 x 5/16 inches. Color shall be in accordance with Section 09915 COLOR SCHEDULE .

Trim units shall include the following:

Wainscot cap: surface bullnose, module size 3 x 6 inches.

External corners: surface bullnose, module size 3 x 6 inches.

Base: flat top cove base, module size 5-3/4 inches high x 6 inches long.

## 2.1.4 Glazed Wall Tile C

Glazed wall tile and trim shall be cushion edged with semi-gloss glaze. Tile shall be nominal 4-1/4 x 4-1/4 x 5/16 inches. Color shall be in

accordance with Section 09915 COLOR SCHEDULE .

Trim units shall include the following:

Wainscot cap: surface bullnose, module size 4-1/4 x 4-1/4 inches.

External corners: surface bullnose, module size 4-1/4 x 4-1/4 inches.

Base: flat top cove base, module size 4-1/4 x 4-1/4 inches.

## 2.2 SETTING-BED

The setting-bed shall be composed of the following:

### 2.2.1 Aggregate for Concrete Fill

Aggregate shall conform to ASTM C 33. Maximum size of coarse aggregate shall not be greater than one-half the thickness of concrete fill.

### 2.2.2 Portland Cement

Cement shall conform to ASTM C 150, Type I, white for wall mortar and gray for other uses.

### 2.2.3 Sand

Sand shall conform to ASTM C 144.

### 2.2.4 Hydrated Lime

Hydrated lime shall conform to ASTM C 206, Type S or ASTM C 207, Type S.

### 2.2.5 Reinforcing Wire Fabric

Wire fabric shall conform to ASTM A 185. Wire shall be either 2 x 2 inch mesh, 16/16 wire or 1-1/2 x 2 inch mesh, 16/13 wire.

## 2.3 WATER

Water shall be potable.

## 2.4 MORTAR, GROUT, AND ADHESIVE

Mortar, grout, and adhesive shall conform to the following:

### 2.4.1 Latex-Portland Cement Mortar

ANSI A118.4.

### 2.4.2 Ceramic Tile Grout

ANSI A118.6; sand portland cement grout latex-portland cement grout .

## 2.5 SLATE THRESHOLDS

Slate thresholds shall be of size required by drawings or conditions.

Slate shall comply with ASTM C 629, II Interior, with fine even grain and honed finish. Color shall be uniform gray and unfading.

Location: V.I.P. toilet room (Room 117) doorway, Ancillary Building toilet room (Room 114) doorway.

### PART 3 EXECUTION

#### 3.1 PREPARATORY WORK AND WORKMANSHIP

Surface to receive tile shall be inspected and shall conform to the requirements of ANSI A108.1 for surface conditions for the type setting bed specified and for workmanship. Variations of surface to be tiled shall fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Latex portland cement mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

#### 3.2 GENERAL INSTALLATION REQUIREMENTS

Tile work shall not be started until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Floor tile installation shall not be started in spaces requiring wall tile until after wall tile has been installed. Tile in colors and patterns indicated shall be applied in the area shown on the drawings. Tile shall be installed with the respective surfaces in true even planes to the elevations and grades shown. Special shapes shall be provided as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Tile bases and coves shall be solidly backed with mortar.

#### 3.3 INSTALLATION OF WALL TILE

Wall tile shall be installed in accordance with the TCA Hdbk, method W243 at metal stud and gypsum board walls; method W202 at masonry walls. Joint size shall be as recommended for each type of tile by manufacturer.

##### 3.3.1 Dry-Set Mortar and Latex-Portland Cement Mortar

Latex-portland cement shall be used to install tile in accordance with ANSI A108.1. Latex portland cement shall be used when installing porcelain ceramic tile and glazed wall tile..

#### 3.4 INSTALLATION OF FLOOR TILE

Floor tile shall be installed in accordance with TCA Hdbk, method F112 at Room 114; F113 at Room 117.

#### 3.4.1 Workable or Cured Mortar Bed

Floor tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. Workable mortar bed materials and installation shall conform to ANSI A108.1. Cured mortar bed and materials shall conform to ANSI A108.1. Joints between porcelain paver tile shall be uniformly 1/4 inch in width.

#### 3.4.2 Dry-Set and Latex-Portland Cement

Latex-portland cement mortar shall be used to install tile directly over properly cured, plane, clean concrete slabs in accordance with ANSI A108.1. Latex portland cement shall be used when installing porcelain paver tile.

#### 3.4.3 Ceramic Tile Grout

Ceramic Tile grout shall be prepared and installed in accordance with ANSI A108.10 and ANSI A118.6.

#### 3.5 INSTALLATION OF SLATE THRESHOLDS

Thresholds shall be installed where indicated in a manner similar to that of the ceramic tile floor. Thresholds shall be the full width of the opening. Head joints at ends shall not exceed 1/4 inch in width and shall be grouted full as specified for ceramic tile.

#### 3.6 EXPANSION JOINTS

Joints shall be formed as indicated and sealed as specified in Section 07920 JOINT SEALANTS.

##### 3.6.1 Walls

Expansion joints shall be provided at control joints in backing material. Wherever backing material changes, an expansion joint shall be installed to separate the different materials.

##### 3.6.2 Floors

Expansion joints shall be provided over construction joints, control joints, and expansion joints in concrete slabs. Expansion joints shall be provided where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Expansion joints shall extend through setting-beds and fill.

#### 3.7 CLEANING AND PROTECTING

Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer's approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with resinous grout or with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a

protective coat of a noncorrosive soap or other approved method of protection. Tiled floor areas shall be covered with building paper before foot traffic is permitted over the finished tile floors. Board walkways shall be laid on tiled floors that are to be continuously used as passageways by workmen. Damaged or defective tiles shall be replaced.

-- End of Section --



## SECTION 09421A

PRECAST TERRAZZO BASE  
**11/95**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 97	(1996) Absorption and Bulk Specific Gravity of Dimension Stone
ASTM C 109/C 109M	(1999) Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 501	(1984; R 1996) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abrasor
ASTM D 2047	(1993) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials
ASTM E 648	(1999) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Standard Products

Materials shall be the standard products of a manufacturer regularly engaged in the manufacture of the material and shall essentially duplicate products that have been in satisfactory use at least 2 years prior to bid opening.

## 1.2.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Terrazzo Base; G, AE.

Drawings indicating pattern, size, style, and color of base.

#### SD-03 Product Data

Installation .

The manufacturer's printed installation instructions for the conditions indicated.

#### SD-04 Samples

Terrazzo Base; G, AE.

Two 4 inch long samples of each type and color of trim pieces and base.

#### SD-07 Certificates

Terrazzo Base.  
Adhesive.

Certificates indicating that the materials conform to the specified requirements and flooring manufacturer's approval of underlayment, adhesive, and cleaners.

#### SD-10 Operation and Maintenance Data

Terrazzo Base.

Six copies of the manufacturer's maintenance literature.

### 1.4 INSTALLER QUALIFICATIONS

Installer shall possess, to the satisfaction of the Contracting Officer, the technical qualifications, experience, trained personnel, and facilities to properly install the specified items.

## 1.5 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in the manufacturer's original unopened containers marked with the manufacturer's brand name, color, and pattern. Materials delivered and placed in storage shall be stored to protect from damage, weather, humidity and temperature variation, dirt and dust, or other contaminants. Temperature of storage area shall not be lower than 50 degrees F or higher than 90 degrees F.

## 1.6 SITE CONDITIONS

Base shall not be installed until other work that could cause damage to the finished flooring has been completed. A temperature of not less than 70 degrees F shall be maintained in all areas where tile is to be installed for a period of not less than 48 hours before, during and after laying of tiles. Tiles shall be brought into installation areas and allowed to condition at not less than 70 degrees F for a period of 48 hours prior to installation. After installation of tiles, a minimum temperature of 55 degrees F shall be maintained.

## 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

## PART 2 PRODUCTS

## 2.1 TERRAZZO TILE

Terrazzo base shall be of colors to match epoxy terrazzo flooring and shall consist of marble and granite chips embedded in a flexible thermoset resin matrix. Base units shall be 3/4 inch thick, 4 inches high and nominal 12 inch length. Tiles shall have a polished finish with uniform color distribution of chips. Base shall have the following properties:

## TERRAZZO TILE PROPERTIES

PROPERTY	TEST METHOD	VALUE
Compressive Strength	ASTM C 109/C 109M	3000 psi minimum
Water Absorption	ASTM C 97	0.7 percent maximum
Abrasive Wear	ASTM C 501	Index 28
Coefficient of Friction	ASTM D 2047	0.5 wet
Flame Spread	ASTM E 84	Class A
Critical Radiant Flux	ASTM E 648	Class I

## 2.2 ADHESIVE

Adhesive shall be flooring and resilient base manufacturer's standard product or a product recommended by the manufacturer.

## 2.3 COLOR

Color shall be in accordance with Section 09915 COLOR SCHEDULE .

## PART 3 EXECUTION

### 3.1 GENERAL

Base shall be provided where indicated.

### 3.2 SUBSTRATE PREPARATION

Holes and cracks shall be filled with mortar. Floors shall be free of curing compounds, grease, dirt, loose particles and other foreign matter that would prevent adhesion. Projecting irregularities shall be chipped or ground smooth. Depressions shall be filled and uneven surfaces leveled. Surfaces shall then be rinsed and allowed to dry prior to applying adhesive.

### 3.3 INSTALLATION

#### 3.3.1 Terrazzo Base

Terrazzo base shall be continuous and adhesively applied. Joints shall be tight and inconspicuous.

### 3.4 CLEANING

Upon completion of the installation and after adhesive has cured, flooring shall be thoroughly cleaned in accordance with the manufacturer's recommendations.

### 3.5 PROTECTION

The terrazzo base work shall be covered and protected from damage until completion of the work of all other trades. Defects which develop, such as loose, broken, or curled tiles, shall be removed and replaced.

-- End of Section --

SECTION 09445A

RESINOUS TERRAZZO FLOORING  
01/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 56 (1998a) Flash Point by Tag Closed Tester

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 99 (1999) Health Care Facilities

NATIONAL TERRAZZO & MOSAIC ASSOCIATION (NTMA)

NTMA Info Guide (1995) Terrazzo Information Guide

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G, AE  
Strips; G, AE  
Control Joint Strips; G, AE

Drawings indicating the type, size, and layout of divider strips and control joint strips.

SD-03 Product Data

Resin  
Mixing, Proportioning, and Installation ,  
Cleaning and Sealing

Resin manufacturer's descriptive data, mixing, proportioning, and installation instructions. Maintenance literature for terrazzo cleaning and sealing shall be included.

## SD-04 Samples

### Resinous Terrazzo Flooring; G, AE

Two 6 x 6 inches, (minimum) samples of each color of resinous terrazzo and two 6 inches lengths, of each type of strip.

## 1.3 GENERAL

Resinous terrazzo flooring, in the colors indicated, shall be applied in the areas shown on the approved detail drawings. Flooring shall be an epoxy terrazzo system that conforms to the requirements specified in paragraphs 2.01A and B of NTMA Info Guide

## 1.4 QUALIFICATION OF INSTALLER

Installers shall be certified in writing by terrazzo manufacturer as qualified to install manufacturer's products and shall have a minimum of 3 years experience in the installation of the materials to be used and shall have completed 8 successful installations within the past 2 years.

Installer shall be a contractor member of the NTMA and shall perform all work in accordance with NTMA standards.

## 1.5 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers. Materials shall be kept in a clean, dry, area with temperatures controlled between 50 to 90 degrees F.

## 1.6 ENVIRONMENTAL REQUIREMENTS

Areas to receive terrazzo shall be maintained at a temperature above 50 degrees F for 2 days prior to installation and for 7 days following installation.

## PART 2 PRODUCTS

### 2.1 PRIMER

Primer shall be a material recommended by the resin manufacturer which will penetrate the pores of the substrate and bond with the topping to form a permanent monolithic bond between the substrate and the topping.

#### 2.1.1 PATCHING AND FILL MATERIAL

Resinous product of or approved by terrazzo manufacturer and recommended by manufacturer for application indicated.

#### 2.1.2 FLEXIBLE REINFORCING MEMBRANE

Manufacturer's resinous membrane for substrate crack preparation and reflective crack reduction.

Reinforcement: fiberglass scrim.

## 2.2 RESIN

Resin for the specified terrazzo flooring shall conform to the requirements shown in NTMA Info Guide.

## 2.3 FILLERS

Fillers, if required, shall be inert mineral or cellulosic material as recommended by the manufacturer and best suited for the resin binder used. Fillers shall be furnished in the quantity necessary to impart the required color and physical characteristics.

## 2.4 MARBLE CHIPS

Marble chips shall be of domestic origin of sizes and colors to match color number indicated in Section 09915 COLOR SCHEDULE. Chips shall be a range of sizes up to and including the NTMA Standard No. 0 and Standard No. 1 for 1/4 in. thick floors and Standard No. 0 through Standard No. 2 for 3/8 in. thick floors.

## 2.5 STRIPS

### 2.5.1 Divider Strips

Divider strips shall be depth as required, 14 gauge and of brass .

### 2.5.2 Control Joint Strips

Control joint strips shall be depth as required, 14 gauge and of brass . Elastomeric filler shall be 1/4 in. inches thick in color to match epoxy resin..

## 2.6 GROUT

Grout shall be as recommended by the manufacturer of the resin.

## 2.7 SEALER

Sealer shall have a pH factor between 7 and 10 and shall be a penetrating type specially prepared for use on terrazzo. The sealer shall not discolor or amber the terrazzo and shall produce a slip resistant surface. Flash point of sealer shall be a minimum of 80 degrees F when tested in accordance with ASTM D 56.

## PART 3 EXECUTION

### 3.1 PREPARATION OF CONCRETE SUBFLOOR

Installation of the floor topping shall not commence until the concrete substrate is at least 28 days old. The concrete surfaces shall be prepared

and tested for dryness characteristics in accordance with the instructions of the resin manufacturer.

Shot-blast concrete surfaces with an apparatus that abrades the concrete surfaces, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.

#### 3.1.1 Flexible Reinforcing Membrane

Prepare and prefill substrate cracks with membrane material.

Install membrane to produce full substrate coverage in areas to receive terrazzo.

#### 3.1.2 Primer

Apply perimer according to manufacturer's instructions. Imbed fiberglass mesh into wet primer at cracks and saturate with additional primer.

### 3.2 MIXING, PROPORTIONING, AND INSTALLATION

Mixing, proportioning, and installing shall be in accordance with the approved instructions of the manufacturer. Strips shall be installed in locations indicated. The topping shall be applied to give a finish thickness of 3/8 in. Bases shall be precast epoxy terrazzo base units as specified in Section 09421A.

### 3.3 CLEANING AND SEALING

The terrazzo shall be washed with a neutral cleaner and where required shall be cleaned with a fine abrasive to remove any stains or cement smears. The cleaned surfaces shall be rinsed. When dry, a terrazzo sealer shall be applied in accordance with the manufacturer's directions.

### 3.4 PROTECTION

The terrazzo work shall be covered and protected from damage until completion of the work of all other trades.

-- End of Section --



## SECTION 09510

## ACOUSTICAL CEILINGS

07/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plates, Sheet and Strip
ASTM A 366/A 366M	(1997e1) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(1998e1) Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 423	(2001) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 635	(2000) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1996) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C 834	(2000e1) Latex Sealants
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 119	(2000a) Fire Tests of Building

Construction and Materials

ASTM E 580	(2000) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E 795	(2000) Mounting Test Specimens During Sound Absorption Tests
ASTM E 1264	(1998) Acoustical Ceiling Products
ASTM E 1414	(2000a) Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
ASTM E 1477	(1998a) Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04	(1998) Seismic Design for Buildings
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UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1999) Fire Resistance Directory (2 Vol.)
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; AE,

Drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

SD-03 Product Data

Acoustical Ceiling Systems; AE,

Manufacturer's descriptive data, catalog cuts, and installation instructions. Submittals which do not provide adequate data for the product evaluation will be rejected.

SD-04 Samples

Acoustical Units; G, AE

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

#### SD-07 Certificates

##### Acoustical Units

Certificate attesting that the mineral based acoustical units furnished for the project contain recycled material and showing an estimated percent of such material.

### 1.3 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be as specified. . The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Reclamation of mineral fiber acoustical ceiling panels to be removed from the job site shall be in accordance with paragraph RECLAMATION PROCEDURES.

#### 1.3.1 Ceiling Sound Absorption

Determine the NRC in accordance with ASTM C 423 Method of Test.

#### 1.3.2 Light Reflectance

Determine light reflectance factor in accordance with ASTM E 1477 Test Method.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

### 1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent shall be maintained for 24 hours before, during, and 24 hours after installation of acoustical units.

### 1.6 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

## 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided. Standard performance guarantee or warranty shall contain an agreement to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

## 1.8 EXTRA MATERIALS

Spare tiles of each color shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

## PART 2 PRODUCTS

### 2.1 ACOUSTICAL UNITS

Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

#### 2.1.1 Units for Exposed-Grid System

Type: III (non-asbestos mineral fiber with painted finish) .

Minimum NRC: 0.70 in all rooms and areas when tested on mounting Type E-400 of ASTM E 795.

Pattern: G.

Nominal size: 24 by 24 inches.

Edge detail: Beveled kerfed and rabbeted.

Finish: Factory-applied standard finish.

Minimum LR coefficient: 0.85.

Minimum CAC: 35.

Flame Spread: Class A, 25 or less

Humidity Resistance: Units shall be warranted for 10 years against visible sag at 104 degrees F/95% relative humidity.

### 2.2 SUSPENSION SYSTEM

Suspension system shall be standard exposed-grid standard width flange , and shall conform to ASTM C 635 for intermediate-duty systems . Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish . Wall molding shall have a flange of not less than

15/16 inch . Standard corners shall be provided. Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of 1/360 of span length. Seismic details shall conform to the guidance in TI 809-04 and ASTM E 580 .

## 2.3 HANGERS

Hangers and attachment shall support a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

### 2.3.1 Wires

Wires shall conform to ASTM A 641/A 641M, Class 1, 0.106 inches in diameter.

## 2.4 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

## 2.5 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components shall be as specified in Section 09915 COLOR SCHEDULE .

# PART 3 EXECUTION

## 3.1 INSTALLATION

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Areas where acoustical units will be cemented shall be free of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Interior finish work such as plastering, concrete, and terrazzo work shall be completed and dry before installation.

Mechanical, electrical, and other work above the ceiling line shall be completed and approved prior to the start of acoustical ceiling installation. Acoustical work shall be provided complete with necessary fastenings, clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an object with the hanger wires, a subsuspension system shall be installed, so that all hanger wires will be plumb.

### 3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended

from underside of steel decking.

#### 3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, hangers shall be provided at a minimum of four hangers per fixture and located not more than 6 inches from each corner of each fixture. See Section 16415A ELECTRICAL WORK, INTERIOR for additional lighting installation requirements.

#### 3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

#### 3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Wall molding shall be secured not more than 3 inches from ends of each length and not more than 16 inches on centers between end fastenings. Wall molding springs shall be provided at each acoustical unit in semi-exposed or concealed systems.

#### 3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating. Scribe and cut tile for accurate fit at borders and around penetrations through tile. At cut edges supported by suspension grid, kerf and rabbet edges to match factory reveal edge to allow units to lie flat within grid.

#### 3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings. See Section 07920 JOINT SEALANTS.

#### 3.2 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

#### 3.4 RECLAMATION PROCEDURES

Ceiling tile, designated for recycling by the Contracting Officer, shall be

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neatly stacked on 4 by 4 foot pallets not higher than 4 foot. Panels shall be completely dry. Pallets shall then be shrink wrapped and symmetrically stacked on top of each other without falling over. Disposal shall be in accordance with Section 01572 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

-- End of Section --

## SECTION 09620A

RESILIENT ATHLETIC FLOORING  
01/98

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 395	(1998) Rubber Property - Compression Set
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991; R 1998) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1054	(1991) Rubber Property - Resilience Using a Rebound Pendulum
ASTM D 1242	(1995a) Resistance of Plastic Materials to Abrasion
ASTM D 1894	(1999) Static and Kinetic Coefficients of Friction of Plastic Film and Sheet
ASTM D 2240	(1997e1) Rubber Property - Durometer Hardness
ASTM D 2632	(1996) Rubber Property-Resilience by Vertical Rebound
ASTM F 1303	(1999) Sheet Vinyl Floor Covering with Backing
ASTM G 21	(1996) Determining Resistance of Synthetic Polymeric Materials to Fungi

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;



submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G, AE

Drawings showing game lines, location of anchor plate assemblies, floor outlets, and under-floor conduit or raceways.

SD-03 Product Data

Installation; ,

Manufacturer's descriptive data and catalog cuts indicating materials of construction and physical characteristics. Installation, cleaning and maintenance instructions shall be included.

SD-04 Samples

Flooring; G, AE

Three samples minimum 9 x 11 inches of each color of flooring material required.

SD-07 Certificates

Materials; ,

Manufacturer's certificates stating that the resilient athletic flooring materials conform to the specified requirements. Labels or markings affixed to manufacturer's products attesting that products meet requirements specified herein will be accepted in lieu of certificates.

1.3 QUALIFICATIONS

Adhesive applied and poured-in-place flooring shall be installed by an experienced floor applicator approved by the manufacturer. Installer must have completed at least ten (10) facilities with the system specified.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in manufacturer's original unopened containers with labels intact. Materials shall not be delivered to the installation area or installed before all work that may damage the materials or the finished floor, such as overhead work, is completed. Materials shall be stored in a clean, dry area. Materials in storage shall be maintained at temperatures recommended by the manufacturer. Protection boards shall be stored flat and off the ground.

## 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

## 1.6 EXTRA MATERIALS

## PART 2 PRODUCTS

### 2.1 URETHANE POURED-IN-PLACE FLOORING TYPE

The resilient poured-in-place urethane surface shall be composed of a seamless pigmented three-layer system, plus primer and top coat, with an average finished system thickness of 1/2 inch..

#### 2.1.1 Materials

Floor system shall consist of polyurethane, and shall contain no lead, mercury, heavy metals, PCBs or formaldehyde. All flooring components, including primer, shall be obtained from a single manufacturer.

##### a. Primer

Material: single-component polyurethane.

##### b. Base Layer

- (1) Material: two-component polyurethane
- (2) Hardness: Shore A 59
- (3) Elongation at break: 130%
- (4) Thickness: 9mm

##### c. Mid Layer

- (1) Material: two-component self-leveling polyurethane
- (2) Hardness: Shore A 80
- (3) Thickness: 2mm

##### d. Top Layer

- (1) Material: two-component polyurethane
- (2) Hardness: Shore D78
- (3) Thickness: 2mm

##### e. Top Coat

Material: two-component polyurethane  
Finish: matte

### 2.2 CRACK FILLER/LEVELER FOR CONCRETE SURFACES

Crack filler/leveler for concrete floor surfaces shall be as recommended by flooring manufacturer.

### 2.3 EDGING STRIPS

Strips shall be of the same material and design as recommended by flooring manufacturer.

### 2.4 GAME LINE MATERIAL

Game line material shall as recommended by the flooring manufacturer and must correspond to the specified flooring product.

### 2.5 SEALANTS

Sealants shall be in accordance with Section 07900 JOINT SEALANTS.

### 2.6 MANUFACTURERS COLOR

Color shall be in accordance with Section 09915 COLOR SCHEDULE .

## PART 3 EXECUTION

### 3.1 PREPARATION

Concrete surfaces shall be completely cured and dry. No curing agents, sealers, or hardeners shall be used to aid in the curing of the concrete slab. Surfaces shall be free of paint spots, and other foreign materials. Surfaces shall be ground down or leveled with an approved leveling compound to a tolerance of plus or minus 1/8 inch within a 10 foot radius. Cracks, construction joints, or damaged portions of floor shall be filled with crack filler for concrete surfaces. Expansion joints shall be filled and sealed in accordance with the approved installation instructions of the manufacturer. All sealants shall be in accordance with ASTM C 920. Expansion joints shall not be filled with a material that will make them inoperable.

Shot-blast concrete surfaces with an apparatus that abrades the concrete surfaces, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

### 3.2 MOISTURE TEST

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content shall be determined by a moisture test as recommended by the flooring manufacturer.

### 3.3 INSTALLATION

#### 3.3.1 General Requirements

Installation shall be in accordance with the approved installation instructions. Tile or sheet flooring shall be rolled with a medium-sized roller in both directions to release entrapped air.

### 3.3.2 Urethane Poured-in-Place Flooring

#### 3.3.2.1 Primer

After subfloor has been thoroughly cleaned and prepared, primer shall be applied using sprayer or paint roller, at an approximate spread rate of 0.1 kg/m<sup>2</sup>.

#### 3.3.2.2 Base Layer

Two-component base layer shall be thoroughly mixed. Base layer shall be applied in 3 lifts, using a notched squeegee, to achieved desired thickness of approximately 3mm per lift (9mm total). The base layer material must be applied wet-to-wet to create a seamless surface. Base layer must cure a minimum of 12 hours before preceding to next application. Total minimum application of base layer shall be 9.0 kg/m<sup>2</sup>.

#### 3.3.2.3 Mid Layer

Two-component mid layer shall be thoroughly mixed. Mid layer shall be applied in one layer, using a notched squeegee. Mid layer must cure a minimum of 12 hours before proceeding to next application. Any imperfections in finished surface must be manually sanded with 150 grit sandpaper. Total minimum application shall be 2.4 kg/m<sup>2</sup>.

#### 3.3.2.4 Top Layer

Two-component top layer shall be thoroughly mixed. Top layer shall be applied in one layer, using a notched squeegee. Top layer must cure a minimum of 12 hours before proceeding to next application. Any imperfections in finished surface must be manually sanded with 150 grit sandpaper. Total minimum application shall be 2.2 kg/m<sup>2</sup>.

#### 3.3.2.5 Top Coat

Two-component top coat shall be thoroughly mixed. Material shall be applied with an airless sprayer at approximately 0.25 kg/m<sup>2</sup>. Top coat must cure a minimum of 18 hours before applying game lines.

#### 3.3.2.6 Game Lines

Use only high-quality masking tape approved by manufacturer. Two-component game line paint must be throughly mixed.

### 3.4 PROTECTION

The installed flooring shall be protected from soiling and damage with heavy reinforced, nonstaining kraft paper, plywood, or hardboard sheets as required. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Protective covering shall be removed when directed by the Contracting Officer.

-- End of Section --

## SECTION 09650

RESILIENT FLOORING  
11/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM D 4078	(2002) Water Emulsion Floor Polish
ASTM E 648	(2000) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F 710	(2003) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
ASTM F 1066	(1999) Vinyl Composition Floor Tile
ASTM F 1303	(2002) Sheet Vinyl Floor Covering with Backing
ASTM F 1344	(2000) Rubber Floor Tile
ASTM F 1482	(2003) Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F 1700	(1999) Solid Vinyl Floor Tile
ASTM F 1859	(2003) Rubber Sheet Floor Covering Without Backing
ASTM F 1860	(2003) Rubber Sheet Floor Covering With Backing
ASTM F 1861	(2002) Resilient Wall Base
ASTM F 1869	(1998) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F 1913	(2002) Vinyl Sheet Floor Covering Without Backing

ASTM F 2034	(2003) Sheet Linoleum Floor Covering
ASTM F 2169	(2002) Resilient Stair Treads
ASTM F 2170	(2002) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs in situ Probes
ASTM F 2195	(2003) Standard Specification for Linoleum Floor Tile

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule #1168	(2003) Adhesive and Sealant Applications
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1.2 FIRE RESISTANCE REQUIREMENTS

Flooring in corridors and exits shall have a minimum average critical radiant flux of 0.45 watts per square centimeter when tested in accordance with ASTM E 648.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Resilient Flooring and Accessories

Manufacturer's descriptive data.

Adhesives

Manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics. Material Safety Data Sheets (MSDS) for all primers and adhesives shall be provided to the Contracting Officer. Highlight VOC emissions.

SD-04 Samples

Resilient Flooring and Accessories; G, AE

Three samples of each indicated color and type of flooring, base, mouldings, and accessories. Sample size shall be minimum 2-1/2 x 4 inches.

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests;

Copy of test reports of moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

SD-08 Manufacturer's Instructions

Surface Preparation  
Installation

Manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Materials shall be stored in a clean dry area with temperature maintained above 68 degrees F and below 85 degrees F, and shall be stacked according to manufacturer's recommendations. Materials shall be protected from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Do not open containers until materials are to be used, except for verification inspection. Observe ventilation and safety procedures specified in the MSDS.

1.5 ENVIRONMENTAL REQUIREMENTS

Areas to receive resilient flooring shall be maintained at a temperature above 68 degrees F and below 85 degrees F for 2 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. A minimum temperature of 55 degrees F shall be maintained thereafter. Observe ventilation and safety procedures specified in the MSDS. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.6 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend

beyond a one year period shall be provided.

#### 1.8 EXTRA MATERIALS

Extra flooring material of each color and pattern shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Extra wall base material composed of 20 linear feet of each type, color and pattern shall be furnished. All extra materials shall be packaged in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Extra materials shall be from the same lot as those installed. Leave extra stock at site in location as directed by Contracting Officer.

### PART 2 PRODUCTS

#### 2.1 RUBBER TILE

Rubber tile shall conform to ASTM F 1344 Class 1 homogeneous , Type A (solid color) , 19.625 inches square. Surface shall be smooth . Overall thickness shall be 0.125 inch thick.

#### 2.2 WALL BASE

Base shall conform to ASTM F 1861, Type TS (vulcanized thermoset rubber) , Style B (coved - installed with resilient flooring) . Base shall be 4 inches high and a minimum 1/8 inch thick. Job formed corners in matching height, shape, and color shall be furnished. Base shall be provided in 120 feet rolls.

#### 2.3 STAIR TREADS

Treads shall conform to ASTM F 2169 Type TS (vulcanized thermoset rubber) . Surface of treads shall conform to ASTM F 2169 Class 1 smooth and have Group 2 strip for visually impaired of contrasting white or off-white color of abrasive material. Nosing shall be square or round.

#### 2.4 MOULDING

Provide tapered mouldings of rubber and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Vertical lip on moulding shall not be greater than 1/4 inch. Change in level between 1/4 and 1/2 inch shall be beveled with a slope no greater than 1:2.

#### 2.5 ADHESIVES

Adhesives for flooring, base and accessories shall be as recommended by the manufacturer and comply with local indoor air quality standards.

#### 2.6 SURFACE PREPARATION MATERIALS

Surface preparation materials, such as panel type underlayment, lining felt, and floor crack fillers shall be as recommended by the flooring manufacturer for the subfloor conditions. Panel type underlayment products



shall comply with ASTM F 1482.

## 2.7 POLISH/FINISH

Polish shall be as recommended by the manufacturer and conform to ASTM D 4078.

## 2.8 CAULKING AND SEALANTS

Caulking and sealants shall be in accordance with Section 07920 JOINT SEALANTS.

## 2.9 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Color, pattern and texture for resilient flooring and accessories shall be in accordance with Section 09915 COLOR SCHEDULE . Flooring in any one continuous area or replacement of damaged flooring in continuous area shall be from same production run with same shade and pattern.

# PART 3 EXECUTION

## 3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer.

## 3.2 SURFACE PREPARATION

Flooring shall be in a smooth, true, level plane, except where indicated as sloped. Floor shall be flat to within 3/16 inch in 10 feet. Subfloor shall be prepared in accordance with flooring manufacturers recommended instructions. The surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) shall be prepared as recommended by the flooring manufacturer. Concrete subfloor preparation shall comply with ASTM F 710. Floor fills or toppings may be required as recommended by the flooring manufacturer. Underlayments when required by the flooring manufacturer shall be installed in accordance with manufacturer's recommended installation instructions. Panel type underlayments shall comply with ASTM F 1482. Before any work under this section is begun, all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete slabs shall have been repaired as recommended by the flooring manufacturer. Concrete curing and sealer compounds, other than the type that does not adversely affect adhesion, shall be entirely removed from the slabs. Paint, varnish, oils, release agents, sealers, waxers, and adhesives shall be removed, as recommended by the flooring manufacturer.

## 3.3 MOISTURE, ALKALINITY AND BOND TESTS

The suitability of the concrete subfloor for receiving the resilient

flooring with regard to moisture content and pH level shall be determined by moisture and alkalinity tests and shall comply with manufacturers recommendations. Moisture testing shall be in accordance with ASTM F 1869 or ASTM F 2170 unless otherwise recommended by the flooring manufacturer. Alkalinity testing shall be as recommended by the flooring manufacturer. The compatibility of the resilient flooring adhesives to the concrete floors shall be determined by a bond test in accordance with the flooring manufacturers recommendations.

#### 3.4 PLACING RUBBER TILE

Rubber tile and accessories shall be installed in accordance with manufacturer's installation instructions. Adhesives shall be prepared and applied in accordance with manufacturers directions. Flooring lines and joints shall be square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary width of edge tiles as necessary to maintain full-size tiles in field, but no edge tile shall be less than one-half full size, except where irregular-shaped rooms makes it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Flooring shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

#### 3.5 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. Moulding shall be secured with adhesive as recommended by the manufacturer. Adhesives shall be prepared and applied in accordance with manufacturers directions.

#### 3.6 PLACING WALL BASE

Wall base shall be installed in accordance with manufacturer's installation instructions. Adhesives shall be prepared and applied in accordance with manufacturers directions. Base joints shall be tight and base shall be even with adjacent resilient flooring. Voids along the top edge of base at masonry walls shall be filled with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners. Voids along the top edge of base at masonry walls shall be filled with caulk.

#### 3.7 PLACING STAIR TREADS

Stair treads shall be securely attached and installed in accordance with manufacturer's installation instructions. Adhesives shall be prepared and applied in accordance with manufacturers directions. Treads shall cover the full width of the stairs. Stairs wider than manufacturer's standard lengths shall have equal length pieces butted together to cover the treads.

### 3.8 CLEANING

Immediately upon completion of installation of flooring in a room or an area, flooring and adjacent surfaces shall be dry-cleaned to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions. No sooner than 5 days after installation, flooring shall be washed with a nonalkaline cleaning solution, rinsed thoroughly with clear cold water, and, except for rubber flooring and stair treads, risers and stringers, vinyl and other flooring not requiring polish by manufacturer, given the number of coats of polish in accordance with manufacturers written instructions. All other flooring shall be cleaned and maintained as recommended by the manufacturer.

### 3.9 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage as recommended by the flooring manufacturer. Flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered shall be removed and replaced.

-- End of Section --

## SECTION 09680

CARPET  
**11/03**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 16	(1998) Test Method: Colorfastness to Light
AATCC 134	(2001) Test Method: Electrostatic Propensity of Carpets
AATCC 165	(1999) Test Method: Colorfastness to Crocking: Carpets - AATCC Crockmeter Method
AATCC 174	(1998) Antimicrobial Activity Assessment of Carpet

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 297	(1993; R 1998) Rubber Products - Chemical Analysis
ASTM D 418	(1993; R 1997) Pile Yarn Floor Covering Construction
ASTM D 1423	(2002) Twist in Yarns by the Direct-Counting Method
ASTM D 1667	(1997) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam)
ASTM D 3278	(1996e1) Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D 3676	(2001) Rubber Cellular Cushion Used for Carpet or Rug Underlay
ASTM D 5252	(2001) Practice for the Operation of the Hexapod Tumble Drum Tester
ASTM D 5417	(1999) Practice for Operation of the

Vettermann Drum Tester

ASTM D 5793 (1995) Standard Test Method for Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings

ASTM D 5848 (1999) Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings

ASTM E 648 (2000) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI 104 (2002) Commercial Carpet Installation Standard

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1630 Standard for the Surface Flammability of Carpet and Rugs (FF 1-70)

40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2551 (1981) Machine-made Textile Floor Coverings - Determination of Dimensional Changes Due to the Effect of Varied Water and Heat Conditions (AACHEN Test)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G, AE

Molding; G, AE

Three copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding.

SD-03 Product Data

Carpet

Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory.

Surface Preparation

Installation

copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

Regulatory Requirements

Three copies of report stating that carpet contains recycled materials and/or involvement in a recycling or reuse program. Report shall include percentage of recycled material.

SD-04 Samples

Carpet; G, AE

Molding; G, AE

a. Carpet: Two "Production Quality" samples 18 x 18 inches of each carpet proposed for use, showing quality, pattern, and color specified.

b. Vinyl or Aluminum Moldings: Two pieces of each type at least 12 inches long.

SD-06 Test Reports

Moisture and Alkalinity Tests;

Three copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

SD-07 Certificates

Carpet

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

Regulatory Requirements;

Report stating that the Carpet Type A contains recycled materials and indicating the actual percentage of recycled material.

SD-10 Operation and Maintenance Data

Carpet;

## Cleaning and Protection

Three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

## 1.3 REGULATORY REQUIREMENTS

Carpet and adhesives shall bear the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet type bearing the label will indicate that the carpet has been tested and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Contractor shall procure carpet in accordance with 40 CFR 247. Carpet shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. Where possible, product shall be purchased locally to reduce emissions of fossil fuels from transporting.

## 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Materials shall be stored in a clean, dry, well ventilated area, protected from damage and soiling, and shall be maintained at a temperature above 60 degrees F for 2 days prior to installation.

## 1.5 ENVIRONMENTAL REQUIREMENTS

Areas in which carpeting is to be installed shall be maintained at a temperature above 60 degrees F for 2 days before installation, during installation, and for 2 days after installation. A minimum temperature of 55 degrees F shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

## 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties including minimum twenty (20) year wear warranty, two (2) year material and workmanship and twenty (20) year tuft bind and delamination.

## 1.7 EXTRA MATERIAL

Extra material from same dye lot consisting of full width continuous broadloom shall be provided for future maintenance. A minimum of two (2) percent of total square yards of each carpet type, pattern, and color shall be provided.

## PART 2 PRODUCTS

## 2.1 CARPET

Carpet shall be first quality; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Carpet materials and treatments shall be reasonably nonallergenic and free of other recognized health hazards. All grade carpets shall have a static control construction which gives adequate durability and performance. Carpet shall bear the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) Label. Carpet type bearing the label will indicate that carpet has been tested and meets the criteria of the CRI Green Label Requirements for Indoor Air Quality Test Criteria.

## 2.1.1 Physical Characteristics

## 2.1.1.1 BROADLOOM CARPET A

Carpet shall comply with the following:

- a. Carpet Construction: Woven .
- b. Type: Broadloom 12 feet minimum usable carpet width .
- c. Pile Type: Cut and loop .
- d. Pile Fiber: Commercial 100% branded (federally registered trademark) nylon continuous filament .
- e. Pile or Wire Height: Minimum .201 inch in accordance with ASTM D 418.
- g. Gauge or Pitch: Minimum 270 in accordance with ASTM D 5793.
- h. Stitches or Rows/Wires: Minimum 8.7 per square inch.
- i. Finished Pile Yarn Weight: Minimum 33 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 5848.
- j. Pile Density: Minimum 5,910.
- k. Dye Method: Solution dyed .
- l. Backing Materials: Primary backing materials shall be those customarily used and accepted by the trade for each type of carpet . Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for gluedown is provided.
- m. Attached Cushion: Attached cushion shall be polyurethane with 3/32 inch thickness and minimum density of 24 lb/cubic foot . Maximum ash content shall not exceed 50 percent when tested in



accordance with ASTM D 297. Cushion will maintain its useful cushioning characteristics and resilient properties without significant deterioration, when tested in accordance with ASTM D-3574 using the 65% deflection method, for the life of the carpet. Carpet and cushion will act as a liquid barrier and keep liquids from penetrating through the backing system, as tested under the British Spill Test, for the life of the carpet.

- n. Recycle Efforts: Use of nylon fiber with 25 per cent minimum recycled content .

#### 2.1.1.2 BROADLOOM CARPET B

Carpet shall comply with the following:

- a. Carpet Construction: Tufted .
- b. Type: Broadloom 12 feet minimum usable carpet width .
- c. Pile Type: Level-loop .
- d. Pile Fiber: Commercial 100% branded (federally registered trademark) nylon continuous filament .
- e. Pile or Wire Height: Minimum 0.136 inch in accordance with ASTM D 418.
- g. Gauge or Pitch: Minimum 1/10 inch in accordance with ASTM D 5793.
- h. Stitches or Rows/Wires: Minimum 9.3 per square inch.
- i. Finished Pile Yarn Weight: Minimum 26 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 5848.
- j. Pile Density: Minimum 6,882.
- k. Dye Method: Solution dyed .
- l. Backing Materials: Primary backing materials shall be those customarily used and accepted by the trade for each type of carpet.
- n. Recycle Efforts: Use of Type 6 recyclable nylon carpet fiber.

#### 2.1.1.3 ENTRANCE CARPET

Carpet shall comply with the following:

- a. Carpet Construction: Needle Felt .
- b. Type: Entrance 19.69 inches square.
- c. Pile Type: Multilevel loop .

- d. Pile Fiber: Commercial 100% branded (federally registered trademark) polypropylene .
- e. Pile or Wire Height: Minimum .250 inch in accordance with ASTM D 418.
- i. Finished Pile Yarn Weight: Minimum 28 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 5848.
- k. Dye Method: Solution dyed .
- l. Backing Materials: Primary backing materials shall be synthetic material . Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for gluedown is provided.

## 2.2 Performance Requirements

- a. ARR (Appearance Retention Rating): Carpet shall be tested and have the minimum 3.5-4.0 (Severe) ARR when tested in accordance with either the ASTM D 5252(Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.
- b. Static Control: Static control shall be provided to permanently control static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC 134.
- c. Flammability and Critical Radiant Flux Requirements: Carpet shall comply with 16 CFR 1630. Carpet in corridors and exits shall have a minimum average critical radiant flux of 0.45 watts per square centimeter when tested in accordance with ASTM E 648.
- d. Tuft Bind: Tuft bind force required to pull a tuft or loop free from carpet backing shall be a minimum 10 pound average force for loop pile and 3 pound average force for cut pile.
- e. Colorfastness to Crocking: Dry and wet crocking shall comply with AATCC 165 and shall have a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.
- f. Colorfastness to Light: Colorfastness to light shall comply with AATCC 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and shall have a minimum 4 grey scale rating after 40 hours.
- g. Delamination Strength: Delamination strength for tufted carpet with a secondary back shall be minimum of 2.5 lbs./inch.

### 2.3 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers for installation of carpet shall be waterproof, nonflammable, meet local air-quality standards, and shall be as required by the carpet manufacturer. Seam adhesive shall be waterproof, nonflammable, and nonstaining as recommended by the carpet manufacturer.

### 2.4 TAPE

Tape for seams shall be as recommended by the carpet manufacturer for the type of seam used in installation.

### 2.5 COLOR, TEXTURE, AND PATTERN

Color, texture, and pattern shall be in accordance with Section 09915 COLOR SCHEDULE .

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Carpet shall not be installed on surfaces that are unsuitable and will prevent a proper installation. Holes, cracks, depressions, or rough areas shall be repaired using material recommended by the carpet or adhesive manufacturer. Floor shall be free of any foreign materials and swept broom clean. Before beginning work, subfloor shall be tested with glue and carpet to determine "open time" and bond.

### 3.2 MOISTURE AND ALKALINITY TESTS

Concrete slab shall be tested for moisture content and excessive alkalinity in accordance with CRI 104.

### 3.3 PREPARATION OF CONCRETE SUBFLOOR

Installation of the carpeting shall not commence until concrete substrate is at least 90 days old. The concrete surfaces shall be prepared in accordance with instructions of the carpet manufacturer. Type of concrete sealer, when required, shall be compatible with the carpet.

### 3.4 INSTALLATION

All work shall be performed by installers who are CFI certified (International Certified Floorcovering Installer Association), or manufacturer's approved installers. Installation shall be in accordance with the manufacturer's instructions and CRI 104. Edges of carpet meeting hard surface flooring shall be protected with molding; installation shall be in accordance with the molding manufacturer's instructions. Ventilation, personal protection, and other safety precautions recommended by the manufacturer of the adhesive shall be followed. Ventilation shall continue for at least 72 hours following installation.

### 3.4.1 Broadloom Installation

Broadloom carpet shall be installed direct glue down and shall be smooth, uniform, and secure, with a minimum of seams. Seams shall be regular, unnoticeable, and treated with a seam adhesive. Side seams shall be run toward the light where practical and where such layout does not increase the number of seams. Breadths shall be installed parallel, with carpet pile in the same direction. Patterns shall be accurately matched. Cutouts, as at door jambs, columns and ducts shall be neatly cut and fitted securely. Seams at doorways shall be located parallel to and centered directly under doors. Seams shall not be made perpendicular to doors or at pivot points. Seams at changes in directions of corridors shall follow the wall line parallel to the carpet direction. Corridors with widths less than 6 feet shall have the carpet laid lengthwise down the corridors. Carpet at V.I.P. suite shall be laid in a diagonal orientation, perpendicular to the NW wall of the room.

### 3.4.2 Entrance Carpet Installation

Tiles shall be installed with release adhesive and shall be snugly jointed together. Tiles shall be laid in the same direction . and shall be smooth, uniform, and secure, with a minimum of seams. Seams shall be regular, unnoticeable, and treated with a seam adhesive. Breadths shall be installed parallel, with carpet pile in the same direction. Patterns shall be accurately matched.

## 3.5 CLEANING AND PROTECTION

### 3.5.1 Cleaning

After installation of the carpet, debris, scraps, and other foreign matter shall be removed. Soiled spots and adhesive shall be removed from the face of the carpet with appropriate spot remover. Protruding face yarn shall be cut off and removed. Carpet shall be vacuumed clean.

### 3.5.2 Protection

The installed carpet shall be protected from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Traffic shall be restricted for at least 45 hours. Protective covering shall be removed when directed by the Contracting Officer.

## 3.6 REMNANTS

Remnants remaining from the installation, consisting of scrap pieces more than 2 feet in dimension with more than 6 square feet total, shall be provided. Non-retained scraps shall be removed from site and recycled appropriately.

-- End of Section --

Z

## SECTION 09840A

ACOUSTICAL WALL TREATMENT  
10/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 16 (1998) Test Method: Colorfastness to Light

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 423 (1999a) Sound Absorption and Sound  
Absorption Coefficients by the  
Reverberation Room Method

ASTM C 612 Specification for Mineral Fiber Block and  
Board Thermal Insulation

ASTM D 1117 (1999) Nonwoven Fabrics

ASTM D 5034 (1995) Breaking Strength and Elongation of  
Textile Fabrics (Grab Test)

ASTM E 84 (2000a) Surface Burning Characteristics of  
Building Materials

## INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC (1997) Uniform Building Code (3 Vol.)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Approved Detail Drawings; G, AE

Drawings showing plan locations, elevations and details.  
Drawings shall include details of method of anchorage, location of

doors and other openings, base detail and shape and thickness of materials.

SD-03 Product Data

Installation

Manufacturer's installation instructions and recommended cleaning instructions.

Acoustical Wall Panels

Manufacturer's descriptive data and catalog cuts.

SD-04 Samples

Acoustical Wall Panels; G, AE

Fabric and vinyl swatches, minimum 18 inches wide by 24 inches long 3 samples of each color range specified.

SD-07 Certificates

Acoustical Wall Panels

Certificates of compliance from an independent laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards. A label or listing from the testing laboratory will be acceptable evidence of compliance.

1.3 DELIVERY AND STORAGE

Materials delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt, dust, or other contaminants.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

PART 2 PRODUCTS

2.1 FABRIC COVERED ACOUSTICAL WALL PANELS

Acoustical wall panels shall consist of prefinished factory assembled, seamless fabric covered, fiber glass or mineral fiber core system as described below. Wall panels shall be manufactured to the dimensions and configurations shown on the approved detail drawings. Perimeter edges shall be reinforced by either an aluminum frame or a formulated resin edge hardener. Acoustical wall panels installed in non-sprinklered areas must comply with the requirements of ICBO UBC, Standard 42-2. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

- a. Panel Width: Widths shall be 48 inches. End panels may vary in width as necessary to cover wall . At sloped roof deck locations, panel width shall be field measured for custom fit within existing purlins.
- b. Panel Height: Panels shall be field measured for custom fit to ceiling. .
- c. Thickness: Panel thickness shall be as indicated .
- d. Fabric Covering: Seamless plain woven 2-ply 100 percent polyester, minimum 15 ounces per linear yard. Tear strength shall be minimum 29 pounds. Tensile strength shall be 150 pounds minimum in accordance with ASTM D 5034. Fabric covering shall be stretched free of wrinkles and then bonded to the edges and back or bonded directly to the panel face, edges, and back of panel a minimum distance standard with the manufacturer. Light fastness (fadeometer) shall be approximately 40 hours in accordance with AATCC 16.
- e. Fire rating for the complete composite system: Class A, 200 or less smoke density and flame spread less than 25, when tested in accordance with ASTM E 84.
- f. Substrate: 6 PCF fiber glass or mineral fiber.
- g. Edge Detail: Square edge.
- h. Core Type: Standard acoustical core.
- i. Mounting: Acoustical panels shall be mounted by manufacturer's standard mechanical fasteners . Mounting shall be directly mounted to wall or mounted to studs to create an air space behind the panels. Drawings indicate required mounting at each location.
- k. Color: Color shall be in accordance with Section 09915 COLOR SCHEDULE. .

## 2.2 FIBERGLASS ACOUSTICAL WALL PANELS WITH MAT SURFACE

Fiberglass wall panels shall consist of rigid fiber glass board with an exposed smooth black mat facing.

- a. Panel Width: Widths shall be 48 inches. Panels shall be field cut for custom fit.
- b. Panel Height: Height shall be 96 inches. Panels shall be field cut for custom fit. .
- c. Thickness: Panel thickness shall be 2 inches .
- d. Exposed Facing: non-woven matt surface adhered to the glass fiber substrate

- e. Fire rating for the complete composite system: Class A, 50 or less smoke density and flame spread less than 25, when tested in accordance with ASTM E 84.
- f. Substrate: 3 PCF fiber glass, Type 1A & 1B in accordance with ASTM C 612.
- g. Edge Detail: Square edge.
- h. Mounting: Acoustical panels shall be mounted by manufacturer's standard mechanical fasteners . Mounting shall be directly mounted to wall or mounted to studs. Drawings indicate required mounting at each location.
- i. Color: Color of exposed mat facing shall be black. .

### PART 3 EXECUTION

#### 3.1 SURFACE CONDITIONS

Walls shall be clean, smooth, oil free and prepared in accordance with panel manufacturer's instructions. Installation shall not begin until all wet work, such as, plastering, painting, and concrete are completely dry.

#### 3.2 INSTALLATION

Panel installation shall be by personnel familiar with and normally engaged in installation of acoustical wall panels. Panels shall be applied in accordance with the manufacturer's installation instructions.

#### 3.3 CLEANING

Following installation, dirty or stained panel surfaces shall be cleaned in accordance with manufacturer's instructions and left free from defects. Panels that are damaged, discolored, or improperly installed shall be removed and new panels provided as directed.

-- End of Section --



## SECTION 09900

PAINTS AND COATINGS  
02/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100Doc (2001) Documentation of the Threshold  
Limit Values and Biological Exposure  
Indices

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1 Scheme for Identification of Piping Systems

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 235 Standard Specification for Mineral Spirits  
(Petroleum Spirits) (Hydrocarbon Dry  
Cleaning Solvent)

ASTM D 523 (1999) Standard Test Method for Specular  
Gloss

ASTM C 669 (1995) Glazing Compounds for Back Bedding  
and Face Glazing of Metal Sash

ASTM C 920 (1998) Elastomeric Joint Sealants

ASTM D 2092 (1995) Preparation of Zinc-Coated  
(Galvanized) Steel Surfaces for Painting

ASTM D 2824 (1994) Aluminum-Pigmented Asphalt Roof  
Coatings, Non-Fibered, Asbestos Fibered,  
and Fibered Without Asbestos

ASTM D 4214 (1998) Evaluating the Degree of Chalking  
of Exterior Paint Films

ASTM D 4263 (1983; R 1999) Indicating Moisture in  
Concrete by the Plastic Sheet Method

ASTM D 4444 (1998) Standard Test Methods for Use and  
Calibration of Hand-Held Moisture Meters

ASTM F 1869 (1998) Measuring Moisture Vapor Emission  
Rate of Concrete Subfloor Using Anhydrous  
Calcium Chloride

## CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000 Air Contaminants  
29 CFR 1910.1001 Asbestos, Tremolite, Anthophyllite, and  
Actinolite  
29 CFR 1910.1025 Lead  
29 CFR 1926.62 Lead Exposure in Construction

## FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1 (Rev J) Obstruction Marking and Lighting

## FEDERAL STANDARDS (FED-STD)

FED-STD-313 (Rev. C) Material Safety Data,  
Transportation Data and Disposal Data for  
Hazardous Materials Furnished to  
Government Activities  
FED-STD-595 (1989 Rev B) Color

## MASTER PAINTERS INSTITUTE (MPI)

MPI 1 (2001) Aluminum Paint  
MPI 2 (2001) Aluminum Heat Resistant Enamel (up  
to 427 C and 800 F)  
MPI 4 (2001) Interior/Exterior Latex Block Filler  
MPI 5 (2001) Exterior Alkyd Wood Primer  
MPI 6 (2001) Exterior Latex Wood Primer  
MPI 7 (2001) Exterior Oil Wood Primer  
MPI 8 (2001) Exterior Alkyd, Flat  
MPI 9 (2001) Exterior Alkyd Enamel  
MPI 10 (2001) Exterior Latex, Flat  
MPI 11 (2001) Exterior Latex, Semi-Gloss  
MPI 13 (2001) Exterior Semi-Transparent Stain  
(Solvent Based)

MPI 16	(2001) Exterior Solid Color Latex Stain
MPI 19	(2001) Inorganic Zinc Primer
MPI 21	(2001)Heat Resistant Enamel, Gloss, (Up to 205 C or 400 F)
MPI 22	(2001) High Heat Resistant Coating
MPI 23	(2001) Surface Tolerant Metal Primer
MPI 26	(2001) Cementitious Galvanized Metal Primer
MPI 27	(2001) Exterior / Interior Alkyd Floor Enamel, Gloss
MPI 31	(2001) Polyurethane, Moisture Cured, Clear Gloss
MPI 39	(2001) Interior Latex-based Wood Primer
MPI 42	(2001) Latex Stucco and Masonry Textured Coating
MPI 44	Interior Latex, Gloss Level 2
MPI 45	(2001) Interior Primer Sealer
MPI 46	(2001) Interior Enamel Undercoat
MPI 47	(2001) Interior Alkyd, Semi-Gloss
MPI 48	(2001) Interior Alkyd, Gloss
MPI 49	(2001) Interior Alkyd, Flat
MPI 50	(2001) Interior Latex Primer Sealer
MPI 51	(2001) Interior Alkyd, Eggshell
MPI 52	(2001) Interior Latex, Gloss Level 3
MPI 54	(2001) Interior Latex, Semi-Gloss
MPI 56	(2001) Interior Alkyd Dry Fog/Fall
MPI 57	(2001) Interior Oil Modified Clear Urethane, Satin
MPI 59	(2001) Interior/Exterior Alkyd Porch & Floor Enamel, Low Gloss
MPI 60	(2001) Interior/Exterior Latex Porch & Floor Paint, Low Gloss

MPI 68	(2001) Interior/Exterior Latex Porch & Floor Paint, Gloss
MPI 71	(2001) Polyurethane, Moisture Cured, Clear, Flat
MPI 72	(2001) Polyurethane, Two Component, Pigmented, Gloss
MPI 77	(2001) Epoxy Cold Cured, Gloss
MPI 79	(2001) Marine Alkyd Metal Primer
MPI 90	(2001) Interior Wood Stain, Semi-Transparent
MPI 94	(2001) Exterior Alkyd, Semi-Gloss
MPI 95	(2001) Fast Drying Metal Primer
MPI 101	(2001) Cold Curing Epoxy Primer
MPI 107	(2001) Rust Inhibitive Primer (Water-Based)
MPI 108	(2001) High Build Epoxy Marine Coating
MPI 110	(2001) Interior/Exterior High Performance Acrylic
MPI 113	(2001) Elastomeric Coating
MPI 116	(2001) Epoxy Block Filler
MPI 119	(2001) Exterior Latex, High Gloss (acrylic)
MPI 134	(2001) Waterborne Galvanized Primer
MPI 138	(2001) High Performance Latex, White and Tints - MPI Gloss Level 2
MPI 139	(2001) High Performance Latex, White and Tints - MPI Gloss Level 3
MPI 140	(2001) High Performance Architectural Latex - Gloss Level 4
MPI 141	(2001) High Performance Semigloss Latex, White and Tints - Gloss Level 5
MPI 144	(2001) Institutional Low Odor / VOC Interior Latex, Gloss Level 2
MPI 145	(2001) Institutional Low Odor / VOC

Interior Latex, Gloss Level 3

MPI 146 Institutional Low Odor/VOC Interior Latex  
- Gloss Level 4 (a 'satin-like' finish)MPI 147 (2001) Institutional Low Odor / VOC  
Interior Latex, Gloss Level 5

## COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-2904 Thinner, Paint, Mineral Spirits, Regular  
and Odorless

## U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101 (Rev. B) Color Code for Pipelines and for  
Compressed Gas Cylinders

## SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SP01-01 (2001) Environmentally Preferable Product  
Specification for Architectural and  
Anti-Corrosive Paints

## STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Guide 6 (1997) Containing Debris Generated During  
Paint Removal OperationsSSPC Guide 7 (1995) Disposal of Lead-Contaminated  
Surface Preparation DebrisSSPC QP 1 (1989) Evaluating Qualifications of  
Painting Contractors (Field Application to  
Complex Structures)SSPC PA 1 (2000) Shop, Field, and Maintenance  
Painting

SSPC Guide 3 (1995) Safety in Paint Application

SSPC VIS 1 (1989) Visual Standard for Abrasive Blast  
Cleaned Steel (Standard Reference  
Photographs)SSPC VIS 3 (1993) Visual Standard for Power- and  
Hand-Tool Cleaned Steel (Standard  
Reference Photographs)SSPC VIS 4 (2001) Guide and Reference Photographs for  
Steel Surfaces Prepared by Waterjetting

SSPC SP 1 (1982) Solvent Cleaning

SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning
SSPC SP 10	(1994) Near-White Blast Cleaning
SSPC SP 12	(1995) Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultra high-Pressure Water Jetting Prior to Recoating
SSPC Paint 18	(1991) Chlorinated Rubber Intermediate Coat Paint

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP01-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Coating; G, AE

Manufacturer's Technical Data Sheets

SD-04 Samples

Color; G, AE

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings G, AE

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings: G, AE

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

### 1.3 APPLICATOR'S QUALIFICATIONS

#### 1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

- a. Name of individual and proposed position for this work.
- b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US) of  
facility owner

Name of individual in facility owner's organization who can be  
contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

#### 1.4 REGULATORY REQUIREMENTS

##### 1.4.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

##### 1.4.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

##### 1.4.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

##### 1.4.4 Asbestos Content

Materials shall not contain asbestos.

##### 1.4.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

##### 1.4.6 Silica

Abrasive blast media shall not contain free crystalline silica.

##### 1.4.7 Human Carcinogens

Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).



### 1.5 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

### 1.6 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01525, "Safety Requirements" and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

#### 1.6.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC Guide 3.

#### 1.6.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

- a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.
- b. 29 CFR 1910.1000.
- c. ACGIH 0100Doc, threshold limit values.
- d. The appropriate OSHA standard in 29 CFR 1910.1025 and 29 CFR 1926.62 for surface preparation on painted surfaces containing lead. Removal and disposal of coatings which contain lead is specified in Section 13281A, "Lead Hazard Control Activities". Additional guidance is given in SSPC Guide 6 and SSPC Guide 7. Refer to drawings for list of hazardous materials located on this project. Contractor to coordinate paint preparation activities with this specification section.
- e. The appropriate OSHA standards in 29 CFR 1910.1001 for surface preparation of painted surfaces containing asbestos. Removal and disposal of coatings which contain asbestos materials is specified

in Section 13281N, "Engineering Control of Asbestos Containing Materials." Refer to drawings for list of hazardous materials located on this project. Contractor to coordinate paint preparation activities with this specification section.

## 1.7 ENVIRONMENTAL CONDITIONS

### 1.7.1 Coatings

Do not apply coating when air or substrate conditions are:

- a. Less than 5 degrees F above dew point;
- b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

## 1.8 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of wall coating systems shall be in accordance with Section 09915 COLOR SCHEDULE .

## 1.9 LOCATION AND SURFACE TYPE TO BE PAINTED

### 1.9.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

- a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
- b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
- c. Existing coated surfaces that are damaged during performance of the work.

## 1.9.1.1 Exterior Painting

Includes new surfaces, existing coated surfaces, of the building and appurtenances as indicated. Also included are existing coated surfaces made bare by cleaning operations.

## 1.9.1.2 Interior Painting

Includes new surfaces existing coated surfaces of the building and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

- a. Exposed columns, girders, beams, joists, and metal deck; and
- b. Other contiguous surfaces.

## 1.9.2 Painting Excluded

Do not paint the following unless indicated otherwise.

- a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.
- b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.
- c. Steel to be embedded in concrete.
- d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.
- e. Hardware, fittings, and other factory finished items.
- f. Surfaces in the following areas shall not be painted:  
Exterior brick walls..

## 1.9.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new and existing surfaces.

- a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.
  - (1) Exposed piping, conduit, and ductwork;
  - (2) Supports, hangers, air grilles, and registers;
  - (3) Miscellaneous metalwork and insulation coverings.
- b. Do not paint the following, unless indicated otherwise:
  - (1) New zinc-coated, aluminum, and copper surfaces under

insulation

(2) New aluminum jacket on piping

(3) New interior ferrous piping under insulation.

#### 1.9.4 Definitions and Abbreviations

##### 1.9.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

##### 1.9.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

##### 1.9.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendering, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

##### 1.9.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

##### 1.9.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

##### 1.9.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

##### 1.9.4.7 EXT

MPI short term designation for an exterior coating system.

## 1.9.4.8 INT

MPI short term designation for an interior coating system.

## 1.9.4.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

## 1.9.4.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

## 1.9.4.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

## 1.9.4.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

## 1.9.4.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

## 1.9.4.14 Paint

See Coating definition.

1.9.4.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.9.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

- a. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, ASTM D 235.

Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

- b. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.
- c. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.
- d. Previously painted surfaces specified to be repainted shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.
- e. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.
- f. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8.
- g. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.
- h. Edges of chipped paint shall be feather edged and sanded smooth.
- i. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.
- j. New, proposed coatings shall be compatible with existing coatings.

#### 3.2.2 Existing Coated Surfaces with Minor Defects

Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings. Remove chalking by sanding so that when tested in accordance with ASTM D 4214, the chalk rating is not less than 8.

#### 3.2.3 Removal of Existing Coatings

Remove existing coatings from the following surfaces:

- a. Surfaces containing large areas of minor defects;
- b. Surfaces containing more than 20 percent peeling area; and
- c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.

#### 3.2.4 Substrate Repair

- a. Repair substrate surface damaged during coating removal;

- b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and
- c. Clean and prime the substrate as specified.

### 3.3 PREPARATION OF METAL SURFACES

#### 3.3.1 Existing and New Ferrous Surfaces

- a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6, or SSPC SP 10. ; Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.
- b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/SSPC SP 12 WJ-3.

#### 3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

#### 3.3.3 Galvanized Surfaces

- a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.
- b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.
- c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Water jet to SSPC SP 12 WJ3 degree of cleanliness.



## 3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

- a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

## 3.3.5 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

## 3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

## 3.4.1 Concrete and Masonry

- a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

- b. Surface Cleaning: Remove the following deleterious substances.

- (1) Dirt, Chalking, Grease, and Oil: Wash new and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

- (2) Fungus and Mold: Wash , existing coated, and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

- (3) Paint and Loose Particles: Remove by wire brushing.

- (4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

- c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.
- d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not

apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

#### 3.4.2 Gypsum Board, Plaster, and Stucco

- a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.
- b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.
- c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

#### 3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

##### 3.5.1 New , Existing Uncoated, and Existing Coated Plywood and Wood Surfaces, Except Floors:

- a. Wood surfaces shall be cleaned of foreign matter.  
  
Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.
- b. Removal of Fungus and Mold: Wash existing coated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, 1 ounce (1/3 cup) household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.
- c. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.
- d. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

- e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.
- f. Cosmetic Repair of Minor Defects:
  - (1) Knots and Resinous Wood and Fire, Smoke, Water, and Color Marker Stained Existing Coated Surface: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.
  - (2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.
  - (3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.
- g. Prime Coat For New Exterior Surfaces: Prime coat wood doors, and trim before wood becomes dirty, warped, or weathered.

### 3.5.2 Interior Wood Surfaces, Stain Finish

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

## 3.6 APPLICATION

### 3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of

adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

- a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.
- b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.
- c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
- d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

### 3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

### 3.6.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration

and sealing shall be as recommended by the manufacturer for each type of substrate.

#### 3.6.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table  
Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking,  
Shingles Paint Table

Division 3. Interior Concrete Paint Table  
Division 4. Interior Concrete Masonry Units Paint Table  
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table  
Division 6. Interior Wood Paint Table  
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces  
Paint Table

- b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.
- c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.
- d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:
- (1) One coat of primer.
  - (2) One coat of undercoat or intermediate coat.
  - (3) One topcoat to match adjacent surfaces.
- e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

#### 3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

- a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

- b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.
- c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.
- d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.
- e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.
- f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

### 3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

### 3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

- a. Apply coatings of Tables in Division 6 for Exterior and Interior.
- b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.
- c. Apply stains in accordance with manufacturer's printed instructions.

### 3.10 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

### 3.11 PAINT TABLES

All DFT's are minimum values.

## 3.11.1 EXTERIOR PAINT TABLES

## DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

## STEEL / FERROUS SURFACES

## A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

## 1. Alkyd

New; MPI EXT 5.1Q-G5 (Semigloss) Existing; MPI REX 5.1D-G5

Primer: Intermediate: Topcoat:

MPI 23 MPI 94 MPI 94

System DFT: 5.25 mils

## B. New Steel that has been blast-cleaned to SSPC SP 6:

## 2. Alkyd

New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5

Primer: Intermediate: Topcoat:

MPI 79 MPI 94 MPI 94

System DFT: 5.25 mils

## C. Existing steel that has been spot-blasted to SSPC SP 6:

## 1. Surface previously coated with alkyd or latex:

Waterborne Light Industrial Coating

MPI REX 5.1C-G5 (Semigloss)

Spot Primer: Intermediate: Topcoat:

MPI 79 MPI 110-G5 MPI 110-G5

System DFT: 5 mils

## 2. Surface previously coated with epoxy:

Waterborne Light Industrial

a. MPI REX 5.1L-G5 (Semigloss)

Spot Primer: Intermediate: Topcoat:

MPI 101 MPI 110-G5 MPI 110-G5

System DFT: 5 mils

## D. New and existing steel blast cleaned to SSPC SP 10:

## STEEL / FERROUS SURFACES

1. Waterborne Light Industrial  
MPI EXT 5.1R-G5 (Semigloss)  
Primer:                      Intermediate:                      Topcoat:  
MPI 101                      MPI 108                      MPI 110-G5  
System DFT: 8.5 mils

E. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

1. Alkyd Floor Enamel  
MPI EXT 5.1S-G6 (Gloss)  
Primer:                      Intermediate:                      Topcoat:  
MPI 79                      MPI 27                      MPI 27 (+NSA)  
System DFT: 5.25 mils

## EXTERIOR GALVANIZED SURFACES

F. New Galvanized surfaces:

- 1.
3. Waterborne Primer / Waterborne Light Industrial Coating  
MPI EXT 5.3J-G5 (Semigloss)  
Primer:                      Intermediate:                      Topcoat:  
MPI 134                      MPI 110-G5                      MPI 110-G5  
System DFT: 4.5 mils

5.

G. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. Waterborne Light Industrial Coating  
MPI REX 5.3J-G5 (Semigloss)  
Primer:                      Intermediate:                      Topcoat:  
MPI 134                      N/A                      MPI 110-G5  
System DFT: 4.5 mils

H. Galvanized surfaces with severely deteriorated coating or rusting:



## EXTERIOR GALVANIZED SURFACES

## 1. Waterborne Light Industrial Coating

MPI REX 5.3L-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 108	MPI 110-G5
System DFT: 8.5 mils		

## EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

I. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

## 2. Waterborne Light Industrial Coating

MPI EXT 5.4G-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 110-G5	MPI 110-G5
System DFT: 5 mils		

J. Surfaces adjacent to painted surfaces; Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish.

## 2. Waterborne Light Industrial Coating

MPI EXT 5.1C-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 110-G5	MPI 110-G5
System DFT: 5 mils		

K. Hot metal surfaces subject to temperatures up to 205 degrees C (400 degrees F):

## 1. Heat Resistant Enamel

MPI EXT 5.2A

Primer:	Intermediate:	Topcoat:
MPI 21	Surface preparation and number of coats per	

## EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

manufacturer's instructions.

System DFT: Per Manufacturer

- L. Ferrous metal subject to high temperature, up to 400 degrees C (750 degrees F):

## 2. Heat Resistant Aluminum Enamel

MPI EXT 5.2B (Aluminum Finish)

Primer: Intermediate: Topcoat:

MPI 2 Surface preparation and number of coats per  
manufacturer's instructions.

System DFT: Per Manufacturer

- M. New surfaces and Existing surfaces made bare cleaning to SSPC SP 10  
subject to temperatures up to 593 degrees C (1100 degrees F):

## 1. Heat Resistant Coating

MPI EXT 5.2D

Primer: Intermediate: Topcoat:

MPI 22 Surface preparation and number of coats per  
manufacturer's instructions.

System DFT: Per Manufacturer

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT  
TABLE

- A. New and Existing, uncoated Dressed lumber, Wood and plywood, trim,  
including top, bottom and edges of doors not otherwise specified:

## 2. Latex

MPI EXT 6.3A-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 7 MPI 11 MPI 11

System DFT: 5 mils

- B. Existing, dressed lumber, Wood and plywood, trim, previously coated with  
an alkyd / oil based finish  
coat not otherwise specified:

## 2. Latex

MPI REX 6.3A-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 5 MPI 11 MPI 11

System DFT: 5 mils

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES PAINT  
TABLE

C. Existing, dressed lumber, Wood and plywood, trim,  
previously coated with a latex  
/ waterborne finish coat  
not otherwise specified:

## 1. Latex

MPI REX 6.3L-G5 (Semigloss)

Spot Primer: Intermediate: Topcoat:

MPI 6 MPI 11 MPI 11

System DFT: 4.5 mils

D. New, Uncoated wood roof decking and sliding wood doors:

## 1. Semi-Transparent Stain

MPI EXT 6.3D

Spot Primer: Intermediate: Topcoat:

N/A MPI 13 MPI 13

System DFT: N/A

DIVISION 10: EXTERIOR CLOTH COVERINGS AND BITUMINOUS COATED SURFACES PAINT  
TABLE

A. Insulation and surfaces of insulation coverings (canvas, cloth, paper):  
(Interior and Exterior Applications)

## 1. Latex

MPI EXT 10.1A-G1 (Flat)

Primer: Intermediate: Topcoat:

N/A MPI 10 MPI 10

System DFT: 3.2 mils

Topcoat: Coating to match adjacent surfaces.

## 3.11.2 INTERIOR PAINT TABLES

## DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. New and uncoated existing and Existing, previously painted Concrete,  
vertical surfaces, not specified otherwise:

## 2. High Performance Architectural Latex

## DIVISION 3: INTERIOR CONCRETE PAINT TABLE

New; MPI INT 3.1C-G3 (Eggshell) / Existing; MPI RIN 3.1J-G3 (Eggshell)

Primer: Intermediate: Topcoat:

MPI 50 MPI 139 MPI 139

System DFT: 4 mils

E. New and uncoated existing and Existing, previously painted concrete floors in following areas: concrete floors, treads and risers in performance area (grandstand)

## 1. Waterborne Concrete Floor Sealer

New; MPI INT 3.2F-G2 (Flat) / Existing; MPI RIN 3.2F-G2 (Flat)

Primer: Intermediate: Topcoat:

MPI 99 MPI 99 MPI 99

System DFT: 5 mils ]

## DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New and uncoated Existing Concrete masonry:

## 1. High Performance Architectural Latex

MPI INT 4.2D-G5 (Semigloss)

Filler Primer: Intermediate: Topcoat:

MPI 4 N/A MPI 141 MPI 141

System DFT: 11 mils

Fill all holes in masonry surface

B. Existing, previously painted Concrete masonry:

## 1. High Performance Architectural Latex

MPI RIN 4.2K-G5 (Semigloss)

Spot Primer: Intermediate: Topcoat:

MPI 50 MPI 141 MPI 141

System DFT: 4.5 mils

## DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

## INTERIOR STEEL / FERROUS SURFACES

- A. Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

## 1. High Performance Architectural Latex

MPI INT 5.1R-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 141	MPI 141
System DFT: 5 mils		

## 2.

- D. Ferrous metal in concealed damp spaces or in exposed areas having unpainted adjacent surfaces as follows:

## 1. Aluminum Paint

MPI INT 5.1M

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 1	MPI 1
System DFT: 4.25 mils		

- E. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

## 1. High Performance Architectural Latex

MPI INT 5.4F-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 141	MPI 141
System DFT: 5 mils		

- F. Hot metal surfaces including smokestacks subject to temperatures up to 205 degrees C (400 degrees F):

## 1. Heat Resistant Enamel

MPI INT 5.2A

Primer:	Intermediate:	Topcoat:
MPI 21	Surface preparation and number of coats per manufacturer's instructions.	
System DFT: Per Manufacturer		

- G. Ferrous metal subject to high temperature, up to 400 degrees C (750 degrees F):

## 1.

## 2. Heat Resistant Aluminum Paint

## INTERIOR STEEL / FERROUS SURFACES

MPI INT 5.2B (Aluminum Finish)

Primer:	Intermediate:	Topcoat:
MPI 2	Surface preparation and number of coats per	
manufacturer's instructions.		
System DFT: Per Manufacturer		

H. New surfaces and Existing surfaces made bare cleaning to SSPC SP 10 subject to temperatures up to 593 degrees C (1100 degrees F):

## 1. High Heat Resistant Coating

MPI INT 5.2D

Primer:	Intermediate:	Topcoat:
MPI 22	Surface preparation and number of coats per	
manufacturer's instructions.		
System DFT: Per Manufacturer		

## DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New and Existing, uncoated Wood and plywood not otherwise specified:

## 1. High Performance Architectural Latex

MPI INT 6.4S-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 141	MPI 141
System DFT: 4.5 mils		

C. New and Existing, previously finished or stained Wood and Plywood, except floors; natural finish or stained:

## 1. Waterborne clear acrylic

New; MPI INT 6.4M-G4 (Satin) / Existing; MPI RIN 6.4M-G4 (Satin)

Primer:	Intermediate:	Topcoat:
MPI 128	MPI 128	MPI 128
System DFT: 4 mils		

## 2. Waterborne clear acrylic over stain

New; MPI INT 6.3W-G4 / Existing; MPI RIN 6.3WG-G4

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 128	MPI 128	MPI 57
System DFT: 4 mils			

I. New Wood Doors; Pigmented finish:

## 1. High performance architectural latex

New; MPI INT 6.3A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 141	MPI 141

DIVISION 6: INTERIOR WOOD PAINT TABLE

System DFT: 4.5 mils

Note: Sand between all coats per manufacturers recommendations.]

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

- A. New Wallboard not  
otherwise specified:

New; MPI INT 9.2A-G3 (Eggshell) / Existing; RIN 9.2A-G3 (Eggshell)

Primer: Intermediate: Topcoat:

MPI 50 MPI 52 MPI 52

System DFT: 4 mils

2. High Performance Architectural Latex - High Traffic Areas

New; MPI INT 9.2B-G3 (Eggshell) / Existing; MPI RIN 9.2B-G3 (Eggshell)

Primer: Intermediate: Topcoat:

MPI 50 MPI 139 MPI 139

System DFT: 4 mils

-- End of Section --

## SECTION 09915

COLOR SCHEDULE  
08/02

## PART 1 GENERAL

## 1.1 GENERAL

This section covers only the color of the exterior and interior materials and products that are exposed to view in the finished construction. The word "color" as used herein includes surface color and pattern. Requirements for quality and method of installation are covered in other appropriate sections of the specifications. Specific locations where the various materials are required are shown on the drawings. Items not designated for color in this section may be specified in other sections. When color is not designated for items, the Contractor shall propose a color for approval.

## 1.2 SUBMITTALS

## PART 2 PRODUCTS

## 2.1 REFERENCE TO MANUFACTURER'S COLOR

Where color is shown as being specific to one manufacturer, an equivalent color by another manufacturer may be submitted for approval. Manufacturers and materials specified are not intended to limit the selection of equal colors from other manufacturers.

## 2.2 COLOR SCHEDULE

The color schedule lists the colors, patterns and textures required for exterior and interior finishes, including both factory applied and field applied colors.

## 2.2.1 Exterior Walls

Exterior wall colors shall apply to exterior wall surfaces including recesses at entrances and projecting vestibules. Conduit shall be painted to closely match the adjacent surface color. Wall color shall be provided to match the colors listed below.

- 2.2.1.1 Brick:  
Watson town Brick Co., #100, smooth solid (match existing brick on main hall)
- 2.2.1.2 Mortar:  
Match existing mortar on main hall.
- 2.2.1.3 Paint:  
Duron CW066W Picket White



- 2.2.1.4 Metal Wall Panels, Hardware, and Associated Trim:  
Metal panels at mechanical enclosures: Match Duron 8356N Mackay Cedar

#### 2.2.2 Exterior Trim

Exterior trim shall be provided to match the colors listed below.

- 2.2.2.1 Steel Doors and Door Frames:  
Duron CW066W Picket White
- 2.2.2.2 Wood Paneled Doors:  
Duron CW066W Picket White
- 2.2.2.3 Aluminum Windows (mullion, muntin, sash, trim, and sill):  
PPG Duranar UC 43350 Bone White
- 2.2.2.4 Wood Stain:  
Clear
- 2.2.2.5 Fascia:  
Duron CW066W Picket White
- 2.2.2.6 Soffits and Ceilings:  
Duron CW066W Picket White
- 2.2.2.7 Overhangs:  
Duron CW066W Picket White
- 2.2.2.8 Downspouts, Gutters, Louvers, and Flashings:  
natural copper
- 2.2.2.9 Caulking and Sealants:  
Match adjacent material
- 2.2.2.10 Control Joints in Masonry:  
match mortar color
- 2.2.2.11 Signage:  
See Section 10440 EXTERIOR SIGNAGE

#### 2.2.3 Exterior Roof

Roof color shall apply to exterior roof surfaces including sheet metal flashings and copings, mechanical units, roof trim, pipes, conduits, electrical appurtenances, and similar items. Roof color shall be provided to match the colors listed below.

- 2.2.3.1 Shingles:  
See Section 07311 ASPHALT SHINGLES
- 2.2.3.2 Penetrations:  
Shall match roof in color.

#### 2.2.4 Interior Floor Finishes

Flooring materials shall be provided to match the colors listed below.

- 2.2.4.1 Carpet A:  
Mohawk "Cedar bay" MC040. Color 1: 07285 Crane Grey; Color 2:  
07257 Midnight Mist
- 2.2.4.2 Carpet B:  
Mohawk "Color Medley" 986 Dark Taupe
- 2.2.4.3 Terrazzo:  
NTMA (via Terrazzo & Marble Supply Companies) #04-284
- 2.2.4.4 Rubber Tile:  
Roppe P178 Pewter
- 2.2.4.5 Stair Treads:  
Roppe P178 Pewter
- 2.2.4.6 Porcelain Paver Tile:  
Crossville A870 Seal Taupe
- 2.2.4.7 Grout:  
Custom Building Products #185 New Taupe
- 2.2.4.8 Walk-Off Mat (Entrance Carpet):  
Mohawk "Luxor", 266 Charcoal
- 2.2.4.9 Concrete Seal:  
Clear
- 2.2.4.10 Fluid-Applied Athletic Flooring:  
Dynamic Sprots Construction, Inc. Blue

#### 2.2.5 Interior Base Finishes

Base materials shall be provided to match the colors listed below.

- 2.2.5.1 Resilient Base and Moldings:  
Roppe P178 Pewter
- 2.2.5.2 Glazed Wall Tile B:  
Natural Hues, QH31 Periwinkle
- 2.2.5.3 Glazed Wall Tile C:  
Dal-Tile 0100 White
- 2.2.5.4 Grout:  
Custom Building Products #185 New Taupe
- 2.2.5.5 Precast Terrazzo:  
NTMA (Terrazzo & Marble Supply Companies) #04-284

- 2.2.5.6 Wood:  
See Section 06200A FINISH CARPENTRY

2.2.6 Interior Wall Finishes

Interior wall color shall apply to the entire wall surface, including reveals, vertical furred spaces, grilles, diffusers, electrical and access panels, and piping and conduit adjacent to wall surfaces unless otherwise specified. Items not specified in other paragraphs shall be painted to match adjacent wall surface. Wall materials shall be provided to match the colors listed below.

- 2.2.6.1 Painted Gypsum Board at Lobbies, Toilet Rooms, Offices, Custodial Closet & all other spaces unless noted otherwise:  
Duron 8690W Snow Ballet

- 2.2.6.2 Painted Gypsum Board at VIP Suite Wainscot:  
  
Duron 8692W Bauhaus Buff

- 2.2.6.3 Painted Gypsum Board at VIP Suite Upper Walls:  
  
Duron 8774M Tankard

- 2.2.6.4 Painted Gypsum Board at Performance Space west wall supply and return air enclosure:  
Duron AC141N Domino

- 2.2.6.5 Painted Gypsum Board walls at Performance Space / Grandstand:  
Duron 8776D Metal Shavings

- 2.2.6.6 Painted Gypsum Board Infill at Grandstand Windows:  
Duron 8774M Tankard

- 2.2.6.7 Fabric-Covered Acoustical Panels:  
At Performance Area ceiling deck: Guilford of Maine 750 Cement Mix  
At Performance Space west wall (supply and return air enclosure):  
Guilford of Maine 408 Black  
At followspot enclosures, control booth, and other wall surfaces:  
Guilford of Maine 750 Cement Mix

- 2.2.6.8 Glazed Wall Tile A:  
Dal-Tile 0100 White

- 2.2.6.9 Glazed Wall Tile B:  
  
Natural Hues QH31 Periwinkle

- 2.2.6.10 Glazed Wall Tile C:  
  
Dal-Tile 0100 White

- 2.2.6.11 Ceramic Tile Grout:  
Custom Building Products #185 New Taupe

- 2.2.6.12 Concrete Columns:  
Duron 8774 Tankard

#### 2.2.7 Interior Ceiling Finishes

Ceiling colors shall apply to ceiling surfaces including soffits, furred down areas, grilles, diffusers, registers, and access panels. Ceiling color shall also apply to joist, underside of roof deck, and conduit and piping where joists and deck are exposed and required to be painted. Ceiling materials shall be provided to match the colors listed below.

- 2.2.7.1 Acoustical Tile and Grid:  
USG Millennia White
- 2.2.7.2 Painted Gypsum Board:  
Duron 8690W Snow Ballet
- 2.2.7.3 Wood Deck:  
Duron 8774M Tankard
- 2.2.7.4 Structural Steel Framing:  
Duron 8775D Metal Shavings
- 2.2.8 Concrete Structure at Lobby (columns, beams, underside of grandstand):  
Duron 8774M Tankard
- 2.2.9 Theatrical Lighting Truss:  
Benjamin Moore 1470
- 2.2.10 Acoustic Reflector Panels (canvas):  
Dyed to match Duron 8773M Dauphin Gray
- 2.2.11 Fabric-Covered Acoustical Panels:  
Guilford of Maine 750 Cement Mix
- 2.2.12 Interior Trim

Interior trim shall be provided to match the colors listed below.

- 2.2.12.1 Steel Doors:  
Duron 8775D Metal Shavings
- 2.2.12.2 Steel Door Frames:  
Duron 8775D Metal Shavings
- 2.2.12.3 Steel Windows (mullion, muntin, sash, trim, and stool):  
Duron 8775D Metal Shavings
- 2.2.12.4 Aluminum Windows (mullion, muntin, sash, trim, and sill):  
PPG Duranar UC 43350 Bone White
- 2.2.12.5 Paneled Wood Doors:  
Duron CW066W Picket White

- 2.2.12.6 Flush Wood Doors  
See Section 08210 WOOD DOORS
- 2.2.12.7 Wood Stain:  
See Section 06200A FINISH CARPENTRY
- 2.2.12.8 Sliding Wood Doors:  
See Section 08165A SLIDING WOOD DOORS
- 2.2.12.9 Window Sills:  
See Section 06200A FINISH CARPENTRY
- 2.2.12.10 Handrails:  
Duron 8775D Metal Shavings
- 2.2.12.11 Ladders:  
Duron 8775D Metal Shavings
- 2.2.12.12 Exposed Ductwork:  
Duron 8775D Metal Shavings
- 2.2.12.13 Closet Shelving:  
See Section 06200A FINISH CARPENTRY

2.2.13 Interior Window Treatment

Window treatments shall be provided to match the colors listed below.

- 2.2.13.1 Window Shades:  
Mecho-Shade Style 6000, Color Graphite

2.2.14 Interior Miscellaneous

Miscellaneous items shall be provided to match the colors listed below.

- 2.2.14.1 Toilet Partitions and Urinal Screens:  
See Section 10153 TOILET PARTITIONS
- 2.2.14.2 Plastic Laminate Counters:  
Wilsonart 4674-60 Evening Tigris
- 2.2.14.3 Solid Surfacing Material:  
Dupont Corian, color: Silt
- 2.2.14.4 Casework:  
See Section 06410A ARCHITECTURAL WOODWORK
- 2.2.14.5 Signage Message Color (excluding handicapped signage):  
Match Duron 8774M Tankard
- 2.2.14.6 Signage Background Color (excluding handicapped signage):  
Match Duron 8690W Snow Ballet

2.2.14.7 Fabric-Covered Acoustical Wall Panels:  
Guilford of Maine 750 Cement Mix

2.2.14.8 Light Fixtures in Performance Space specified to receive custom  
finish:

Match Duron 8775D Metal Shavings

2.2.14.9 Electrical Panels:  
Covers in finished areas of building (outside mechanical,  
electrical and other service spaces) shall match that of wall in  
which panel is placed.

2.2.14.10 Shower Wall Kits, Trim and Shower Pan:  
Kohler, white

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 09981N

LINSEED OIL PROTECTION OF CONCRETE SURFACES  
**09/98**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 309	(2003) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM D 235	(2002) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 260	(1986; R 2001) Boiled Linseed Oil

1.2 DELIVERY, STORAGE AND HANDLING

Deliver the linseed oil-mineral spirit compound in original sealed containers that show the designated name, specification number, batch number, date of manufacture, manufacturer's directions, and name of manufacturer. Linseed oil-mineral spirits compound has a flash point of about 100 degrees F and is readily flammable. Carefully guard against fire. Store wiping rags containing this material in metal cans with tight lids.

1.3 ENVIRONMENTAL CONDITIONS

Apply coating when air and concrete temperature are between 35 degrees F and 100 degrees F.

1.4 TRAFFIC CONTROL

Allow no traffic, except sealing equipment, on the treated surface until dry.

1.5 EQUIPMENT

1.5.1 Brushes and Rollers

Use brush with sufficient body and length of bristle to spread the compound in a uniform film. Use rollers of a type which do not leave a stippled texture.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Linseed Oil-Mineral Spirits Compound

A blend of 60 percent boiled linseed oil conforming to ASTM D 260, Type I and 40 percent mineral spirits conforming to ASTM D 235, Type I, by volume.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Prepare hardened concrete surfaces to permit sealer penetration. Use airblasting, sandblasting, waterblasting or other approved methods. Immediately before sealer application, remove dust by airblasting.

3.2 APPLICATION

3.2.1 Rate of Application

3.2.1.1 Hardened Concrete

Two coat application of linseed oil-mineral spirits compound:

- a. First Coat: one gallon per 360 square feet.
- b. Second Coat: one gallon per 600 square feet. Apply the second coat as soon as the first coat is dry to the touch.

3.2.2 Method of Application

Apply using brush and roller technique.

-- End of Section --



SECTION 10153

TOILET PARTITIONS  
11/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

THE NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191                      Americans with Disabilities Act (ADA)  
                                    Accessibility Guidelines for Buildings and  
                                    Facilities

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003                      (Basic) Partitions, Toilet, Complete

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G, AE

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

SD-03 Product Data

Toilet Partition System

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

SD-04 Samples

Colors and Finishes

Manufacturer's standard finish samples.

### 1.3 SYSTEM DESCRIPTION

Toilet partition system, including toilet enclosures and urinal screens, shall be a complete and usable system of panels, hardware, and support components. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. The partition system shall be provided by a single manufacturer, and shall be a standard product as shown in the most recent catalog data. The partition system shall be as shown.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated; free from dust, water, or other contaminants; and shall have easy access for inspection and handling.

### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to CID A-A-60003, Type I, Style C, overhead braced. Width, length, and height of toilet enclosures shall be as shown.

Finish surface of panels shall be stainless steel. Panels indicated to receive toilet paper holders or grab bars as specified in Section 10800 TOILET ACCESSORIES, shall be reinforced for mounting of the items required.

Grab bars shall withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars shall not rotate within their fittings.

### 2.2 URINAL SCREENS

Urinal screens shall conform to CID A-A-60003, Type III, Style wall-hung. Finish surface of screens shall be stainless steel. Width and height of urinal screens shall be as shown.

### 2.3 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Hardware finish shall be highly resistant to alkalies, urine, and other common toilet room acids. Latching devices and hinges for handicap compartments shall comply with 36 CFR 1191 and shall be chrome-plated steel or stainless steel door latches that operate without either tight grasping or twisting of the wrist of the operator.

## 2.4 COLORS AND FINISHES

### 2.4.1 Colors

Color of finishes for toilet partition system components shall be manufacturer's standard .

### 2.4.2 Finishes No. 1 through No. 3

Partitions, panels, screen, and door finishes shall conform to CID A-A-60003 and shall be Finish No. 2, stainless steel .

## PART 3 EXECUTION

### 3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb with uniform clearance of 1/2 inch between pilasters and panels; 1 inch between pilasters and walls; and not more than 3/16 inch between pilasters and doors, in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction.

Where indicated, anchorage of toilet partitions to walls shall be by toggle-bolting. Wall-hung urinal screens shall be through-bolted through full-height continuous stainless steel or aluminum flange. Flange shall be screw-attached to solid wood blocking in wall. Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work. In the finished work, conceal evidence of drilling in floors and walls. Screws and bolts shall be stainless steel.

### 3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched. Baked enamel finish shall be touched up with the same color of paint that was used for the finish. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

-- End of Section --

## SECTION 10201N

METAL WALL LOUVERS  
**09/99**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1980) Aluminum Finishes

## AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2603 (1992; Addendum 1993) Pigmented Organic Coatings on Extruded Aluminum

## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500-D (1991) Louvers, Dampers and Shutters

AMCA 511 (1991) Certified Ratings Program for Air Control Devices

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167 (1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A 366/A 366M (1997) Commercial Quality (CS) Steel, Carbon (0.15 Maximum Percent), Cold-Rolled

ASTM A 653/A 653M (1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B 209M (1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 221M (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

ASTM B 221 (1996) Aluminum and Aluminum-Alloy

Extruded Bars, Rods, Wire, Profiles, and  
Tubes

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Wall louvers

Show all information necessary for fabrication and installation of louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

SD-04 Samples

Wall louvers; G, AE

Door louvers; G, AE

Colors of finishes shall closely approximate colors indicated. Where color is not indicated, submit the manufacturer's standard colors to the Contracting Officer for selection.

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Sheet

ASTM A 653/A 653M, coating designation G90.

2.1.2 Aluminum Sheet

ASTM B 209, alloy 3003 or 5005 with temper as required for forming.

2.1.3 Extruded Aluminum

ASTM B 221, alloy 6063-T5 or -T52.

2.1.4 Cold Rolled Steel Sheet

ASTM A 366/A 366M, Class 1, with matte finish. Use for interior louvers only.

## 2.2 METAL WALL LOUVERS

Weather resistant type, with bird screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. The rating shall show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute.

### 2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

### 2.2.2 Formed Metal Louvers

Formed of zinc-coated steel sheet not thinner than 16 U.S. gage, or aluminum sheet not less than 0.08 inch thick.

### 2.2.3 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions for all louvers more than 5 feet in width at not more than 5 feet on centers. Provide mullions covers on both faces of joints between louvers.

### 2.2.4 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. For steel louvers, provide 1/2 inch square mesh, 12 or 16 gage zinc-coated steel; 1/2 inch square mesh, 16 gage copper; or 1/4 inch square mesh, 16 gage zinc-coated steel or copper bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

## 2.3 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.

## 2.4 FINISHES

### 2.4.1 Aluminum

Provide factory-applied organichigh-performance coating.

#### 2.4.1.1 High-Performance Coating

Exposed surfaces of aluminum windows shall be finished with a two-coat fluoropolymer coating system containing at least 70 percent by weight polyvinylidene fluoride, PVF2 resin, factory-applied, oven-baked, conforming to AAMA 2604, with a primer coat of 0.20 to 0.30 mils and a color coat of minimum 1.0 mil, total dry film thickness of 1.20 to 1.3 mils.

Finish shall be free of scratches and other blemishes.

2.4.1.2 Color

Color shall be selected from manufacturers standard colors.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Door Louvers

Install louvers in wood doors by using metal "Z" or "L" moldings. Fasten moldings to door with screws.

3.1.3 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Copper or Copper-Bearing Alloys

Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.

3.2.2 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.3 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.4 Wood

Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

-- End of Section --

## SECTION 10430

EXTERIOR SIGNAGE  
11/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic the designation only.

## ALUMINUM ASSOCIATION (AA)

AA DAF-45 (2003) Designation System for Aluminum  
Finishes

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; R 1994) Safety Glazing Materials  
Used in Buildings

## AMERICAN WELDING SOCIETY (AWS)

AWS C1.1M/C1.1 (2000) Resistance Welding

AWS D1.1/D1.1M (2002) Structural Welding Code - Steel

AWS D1.2 (2003) Structural Welding Code - Aluminum

## ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings  
on Iron and Steel Products

ASTM A 36/A 36M (2003a) Carbon Structural Steel

ASTM A 570/A 570M (1998) Steel, Sheet and Strip, Carbon,  
Hot-Rolled

ASTM A 653/A 653M (2003) Steel Sheet, Zinc-Coated  
(Galvanized) or Zinc-Iron Alloy-Coated  
(Galvannealed) by the Hot-Dip Process

ASTM A 924/A 924M (1999) General Requirements for Steel  
Sheet, Metallic-Coated by the Hot-Dip  
Process

ASTM B 108 (2003a) Aluminum-Alloy Permanent Mold  
Castings



ASTM B 209	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	(2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 26/B 26M	(2003) Aluminum-Alloy Sand Castings
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM C 1036	(2001) Flat Glass
ASTM D 3841	(1997; R 2001) Glass-Fiber-Reinforced Polyester Plastic Panels
ASTM E 84	(2003) Surface Burning Characteristics of Building Materials

## NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MFM	(1988) Metal Finishes Manual
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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## SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS3611	(1994; Rev D) Plastic Sheet, Polycarbonate General Purpose
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Approved Detail Drawings; G, AE

Drawings showing elevations of each type of sign; dimensions,

details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message shall be included.

#### SD-03 Product Data

##### Modular Exterior Signage System

Manufacturer's descriptive data and catalog cuts.

##### Installation

Manufacturer's installation instructions and cleaning instructions.

##### Wind Load Requirements

Design analysis and supporting calculations performed in support of specified signage.

#### SD-04 Samples

##### Exterior Signage; G, AE

One sample of each type of sign . Sample shall consist of a single letter, in specified size and finish. Samples may be installed in the work, provided each sample is identified and location recorded.

### 1.3 GENERAL

All exterior signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Recyclable materials shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

### 1.4 WIND LOAD REQUIREMENTS

Exterior signage shall be designed to withstand 90 mph windload.

### 1.5 CHARACTER PROPORTIONS AND HEIGHTS

Letters and numbers on indicated signs for handicapped-accessible buildings shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

## 1.6 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

## 1.7 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

## 1.8 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

## PART 2 PRODUCTS

### 2.1 DIMENSIONAL BUILDING LETTERS

#### 2.1.1 Fabrication

Letters shall be fabricated from cast bronze . Letters shall be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters shall be packaged for protection until installation.

#### 2.1.2 Typeface

Typeface shall be as indicated.

#### 2.1.3 Size

Letter size shall be as indicated.

#### 2.1.4 Finish

Oxidized bronze with clear coat finish shall be provided.

#### 2.1.5 Mounting

Steel U-bracket, cap screws, and expansion bolts of number and size as recommended by manufacturer, shall be used for concealed anchorage. Letters which project from the building line shall have stud spacer sleeves. Letters, studs, and sleeves shall be of the same material. Templates for mounting shall be supplied.

### 2.2 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 209 for sheet or plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings. Aluminum extrusions shall be provided at least 1/8 inch thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products

shall conform to AWS C1.1M/C1.1.

## 2.3 ORGANIC COATING

Surfaces shall be cleaned, primed, and given a two-component acrylic polyurethane finish in accordance with NAAMM MFM, AMP 505, with total dry film thickness not less than 1.2 mils.

## 2.4 STEEL PRODUCTS

Structural steel products shall conform to ASTM A 36/A 36M. Sheet and strip steel products shall conform to ASTM A 570/A 570M. Welding for steel products shall conform to AWS D1.2.

## 2.5 CAST BRONZE

Components shall be fabricated with sharp corners, flat faces, and accurate profiles. Burrs and rough spots shall be removed and polished. Faces shall be finished to a uniform high luster. Cast bronze shall be in accordance with ASTM B 62.

## 2.6 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish and shall be non-rusting, non-corroding, and non-staining. Exposed fasteners shall be tamper-proof.

## 2.7 SHOP FABRICATION AND MANUFACTURE

### 2.7.1 Factory Workmanship

Work shall be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding to or on structural steel shall be in accordance with AWS D1.1/D1.1M. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practical. Items specified to be galvanized shall be by hot-dip process after fabrication if practical. Galvanization shall be in accordance with ASTM A 123/A 123M and ASTM A 653/A 653M, as applicable. Other metallic coatings of steel sheet shall be in accordance with ASTM A 924/A 924M. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

### 2.7.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

### 2.7.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete shall not be painted. Upon completion of work, damaged surfaces shall be recoated.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Signs, plaques, or dimensional letters shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed.

#### 3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

#### 3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, the Contractor shall cover all project identification, directional, and other signs which may mislead the public. Covering shall be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Signs shall be cleaned, as required, at time of cover removal.

### 3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames shall be field painted in accordance with Section 09900 PAINTS AND COATINGS. Anodized metals, masonry, and glass shall be protected from paint. Finish shall be free of scratches or other blemishes.

-- End of Section --

## SECTION 10440

INTERIOR SIGNAGE  
07/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ALUMINUM ASSOCIATION (AA)

- |           |   |
|-----------|---|
| AA DAF-45 | (1997) Designation System for Aluminum Finishes   |
| AA PK-1   | (1999) Registration Record of Aluminum Association Alloy Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot |

## AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

- |          |  |
|----------|--|
| AAMA 605 | (1998) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels |
|----------|--|

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |            |   |
|------------|---|
| ANSI Z97.1 | (1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings |
|------------|---|

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |             |  |
|-------------|--|
| ASTM B 209  | (1996) Aluminum and Aluminum-Alloy Sheet and Plate   |
| ASTM B 209M | (2000) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)                                |
| ASTM B 221  | (2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes          |
| ASTM B 221M | (2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) |

ASTM C 1036 (1991; R 1997) Flat Glass

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2 (1997) Structural Welding Code - Aluminum

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Detail Drawings; G, AE

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included.

### SD-03 Product Data

Installation; G, AE

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

### SD-04 Samples

Interior Signage; G, AE

One sample of each of the following sign types showing typical quality and workmanship. The samples may be installed in the work, provided each sample is identified and location recorded.

b. Door identification sign.

Two samples of manufacturer's standard color chips for each material requiring color selection.

### SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions

Protection and Cleaning

Six copies of operating instructions outlining the step-by-step

procedures required for system operation shall be provided. The instructions shall include simplified diagrams for the system as installed. Six copies of maintenance instructions listing routine procedures, repairs, and guides shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number.

### 1.3 GENERAL

Interior signage shall be of the types and message content described below, shall conform to the requirements specified, and shall be provided at the locations described below. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Recyclable materials shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

#### 1.3.1 Room Identification Signage

Provide signage at the entrances to the following spaces, with message content as shown:

- a. Unisex HC 103; (graphic man/woman symbol, graphic HC symbol, braille text "Men's/Women's HC Toilet")
- b. Men 104; (graphic man symbol), braille text "Men's Toilet"
- c. Unisex HC 114; (graphic man/woman symbol, graphic HC symbol, braille text "Men's/Women's HC Toilet")
- d. VIP Toilet 117; (graphic men/women symbol, graphic HC symbol), braille text "Men's/Women's HC Toilet"
- e. Women 120; (graphic woman symbol) braille text "Women's Toilet"
- f. Unisex HC 121; (graphic men/women symbol, graphic HC symbol), braille text "Men's/Women's HC Toilet"

#### 1.3.2 Character Proportions and Heights

Letters and numbers on indicated signs in handicapped-accessible buildings, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 3 inches.

#### 1.3.3 Raised and Brailled Characters and Pictorial Symbol Signs (Pictograms)

Letters and numbers on indicated signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be raised 1/32 inch upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 5/8 inch in height, but no



higher than 2 inches. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 inches minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

#### 1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

#### 1.5 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.1 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

Signs shall be fabricated of or acrylic plastic conforming to ANSI Z97.1 , painted with low VOC paint. See Section 09915 COLOR SCHEDULE for color.

##### 2.1.1 Standard Room Signs

Signs shall consist of matte finish acrylic plastic . Units shall be frameless . Corners of signs shall be squared .

##### 2.1.2 Type of Mounting For Signs

Surface mounted signs shall be provided with 1/16 inch thick vinyl foam tape.

##### 2.1.3 Graphics

Signage graphics for modular identification/directional signs shall conform to the following:

Graphics shall be raised 1/32 inch with background painted with low VOC paint . See Section 09915 COLOR SCHEDULE for color.

#### 2.2 FABRICATION AND MANUFACTURE

##### 2.2.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

### 2.2.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

### 2.3 COLOR, FINISH, AND CONTRAST

Color shall be as selected by Architect from Manufacturer's full range.. In buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Required blocking shall be installed as detailed. Signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach within 3 inches of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions.

#### 3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions.

Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 5 mil green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance.

#### 3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass,

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frames, and other sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

-- End of Section --

SECTION 10800

TOILET ACCESSORIES  
07/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036 (1991; R 1997) Flat Glass

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes; G, AE  
Accessory Items; G, AE

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, operation instructions, and cleaning instructions.

SD-04 Samples

Finishes; G, AE  
Accessory Items; G, AE

One sample of each accessory proposed for use. Approved samples may be incorporated into the finished work, provided they are identified and their locations noted.

SD-07 Certificates

Accessory Items

Submit for each type of accessory specified, attesting that the items meet the specified requirements.

### 1.3 DELIVERY, STORAGE, AND HANDLING

Toilet accessories shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area protected from construction damage and vandalism.

### 1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 MANUFACTURED UNITS

Toilet accessories shall be provided where indicated in accordance with paragraph SCHEDULE. Each accessory item shall be complete with the necessary mounting plates and shall be of sturdy construction with corrosion resistant surface.

#### 2.1.1 Locks and Keys

Where specified, units shall be equipped with tumbler locks. All locks shall be keyed alike, except that coin box lock on napking/tampon vendor shall be keyed differently.

#### 2.1.2 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be suited for use with the supporting construction. Exposed fasteners shall have oval heads and shall be finished to match the accessory.

#### 2.1.3 Finishes

Except where noted otherwise, finishes on metal shall be provided as follows:

<u>Metal</u>	<u>Finish</u>
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

### 2.2 ACCESSORY ITEMS

Accessory items shall conform to the requirements specified below.

#### 2.2.1 Grab Bar (GB)

Grab bar shall be 18 gauge, 1-1/2 inches OD Type 304 stainless steel.

Grab bar shall be form and length as indicated. Concealed mounting flange shall have mounting holes concealed by snap flange. Grab bars ends shall be welded to flanges to form one structural unit. Grab bar shall have satin finish. Installed bars shall be capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Space between wall and grab bar shall be 1-1/2 inch.

#### 2.2.2 Framed Mirrors

Framed mirrors shall have one-piece roll formed frame, 3/4 inches by 3/4 inches, type 304 stainless steel angle with satin finish. Corners shall be welded, ground and polished smooth. Mirror glass shall be Type I transparent flat type, Class 1-clear. Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Glass shall be guaranteed against silver spoilage for 15 years. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror edges shall be protected with plastic filler strips to prevent chipping; back shall be protected by 3/16 inch thick, water-resistant, polyethylene padding. Unit shall have galvanized steel back attached to frame with concealed screws. Unit shall attach to wall hanger with two theft-resistant locking screws.

#### 2.2.3 Mirror, Tilt (MT)

Tilt mirror shall be surface mounted and shall provide full visibility for persons in a wheelchair. Mirror shall have fixed tilt, extending at least 4 inches from the wall at the top and tapering to 1 inch at the bottom. Size shall be in accordance with the drawings. Glass for mirrors shall conform to ASTM C 1036, and mirror unit and glass shall conform to paragraph Framed Mirrors.

#### 2.2.4 Recessed Paper Towel Dispenser, Countertop Mount (PTD)

Paper towel dispenser shall be all-welded construction and shall be constructed of not less than 0.269 inch Type 304 stainless steel, and shall be recessed, mounted in countertop.. Dispenser shall be top-loading and equipped with two hinged towel retainers and spring-loaded towel tray; capacity shall be 300 C-fold or multifold paper towels.

#### 2.2.5 Combination Paper Towel Dispenser/Waste Receptacle Units (PTDWR)

Dispenser/receptacle shall be recessed and shall have a capacity of 350 sheets of C-fold, single-fold, or quarter-fold towels. Waste receptacle shall be designed to be locked in unit and removable for service. Locking mechanism shall be tumbler key lock. Waste receptacle shall have a capacity of 2 gallons. Unit shall be fabricated of not less than 0.30 inch stainless steel welded construction with all exposed surfaces having a

satin finish. Waste receptacle that accepts reusable liner standard for unit manufacturer shall be provided.

#### 2.2.6 Waste Receptacle

Waste receptacle shall be recessed and shall have a capacity of 12 gallons.

Receptacle shall be of all-welded stainless steel construction; exposed surfaces shall have satin finish. Removable waste receptacle shall be secured to cabinet with a tumbler lock. Front and side edges of bottom and all top edges shall be hemmed for safe handling.

#### 2.2.7 Sanitary Napkin and Tampon Dispenser (SNTD)

Sanitary napkin and tampon dispenser shall be surface mounted. Dispenser, including door shall be Type 304 stainless steel and shall dispense both napkins and tampons with a minimum capacity of 20 each. Dispensing mechanism shall be for coin operation. Coin mechanisms shall have denomination of 25 cents. Doors shall be hung with a full-length stainless steel piano hinge and secured with a tumbler lock. Keys for coin box shall be different from the door keys. Unit shall carry no brand-name advertising.

#### 2.2.8 Soap Dispenser (SD)

Soap dispenser shall be lavatory mounted, liquid and lotion type consisting of a shatter-resistant polyethylene tank with a minimum 20 fluid ounces holding capacity and a 6 inch spout length. Valve shall be operable with one hand to comply with barrier-free accessibility guidelines. Piston and spout assembly shall be type-304 stainless steel with bright polished finish. Escutcheon shall lock to body with concealed locking mechanism that is opened only with special key provided. Spout shall rotate 360 degrees without damage to valve mechanism. Piston, spout, and supply-tube assembly shall be removable from top for filling and maintenance.

#### 2.2.9 Robe Hook(TP)

Robe hook shall have concealed wall fastenings, and a pin integral with or permanently fastened to wall flange. Maximum projection shall be 4 inches.

Design shall be consistent with design of other accessory items. Finish shall be satin.

#### 2.2.10 Toilet Tissue Dispenser, Partition Mounted (TTD)

Toilet tissue holder shall be partition-mounted, serving two toilet compartments with two rolls of standard tissue stacked vertically available at each toilet compartment. Cabinet shall be stainless steel, all-welded construction, satin finish. Unit shall have tumbler lock. Spindles shall be theft-resistant, heavy-duty, one-piece, molded ABS. Formed ends shall retain spindle in dispensing mechanism when door is locked. Empty cores are removed only after unlocking door.

#### 2.2.11 Combination Toilet Tissue Dispenser and Napkin Disposal, Partition Mounted (TTDJ)

Toilet tissue dispenser shall be partition mounted with 2 rolls of standard tissue stacked vertically available at each toilet compartment.. Cabinet shall be fabricated of Type 304, 18 gauge stainless steel . Door and permanent panel shall be of one-piece seamless construction. Door shall be secured to cabinet with a full-length stainless steel piano hinged and equipped with a tumbler lock. Disposal panels shall be of Type 304, 22-gauge stainless steel with hemmed edges, secured to door and permanent panel with spring-loaded, full-length stainless steel piano hinge. Disposal panels shall be equipped with international graphic symbols identifying napking disposal. Waste receptacle shall be leak-proof molded polyethylene, capacity .8 gallons, and capable of accommodating disposable liners.

#### 2.2.12 Toilet Tissue Dispenser, Surface Mounted

Toilet tissue holder shall be surface-mounted, with two rolls of standard tissue stacked vertically. Cabinet shall be 22-gauge stainless steel, all-welded construction, with satin finish. Extra roll shall automatically drop into place when bottom roll is depleted. Unit shall be equipped with two theft-resistant, heavy-duty, one-piece molded ABS spindles. Door shall be secured to cabinet and equipped with a tumbler lock.

#### 2.2.13 Combination Toilet Tissue Dispenser and Napkin Disposal, Surface Mounted

Toilet tissue dispenser shall be partition mounted with 2 rolls of standard tissue stacked vertically. Cabinet shall be fabricated of Type 304, 18-gauge stainless steel, all-welded construction. Disposal panel shall be self-closing, secured to cabinet with a spring-loaded full-length stainless steel piano-hinge and equipped with an international graphic symbol identifying napkin disposal. Waste receptacle shall be leak-proof molded polyethylene, capacity .8 gallons, and capable of accommodating disposable liners.

#### 2.2.14 Sanitary Napkin Disposal Unit

Surface-mounted sanitary napkin disposal shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Door shall be secured to cabinet with a full-length stainless steel piano-hinge and equipped with a tumbler lock keyed like other Bobrick washroom accessories. Unit shall have a self-closing panel covering disposal opening. Panel shall have bottom edge hemmed for safety, be secured to door with a spring-loaded, full-length stainless steel piano-hinge, and equipped with an international graphic symbol identifying sanitary napkin disposal. Unit shall be furnished with a removable, leak-proof, rigid molded polyethylene receptacle. Receptacle shall have a capacity of 1.2 gal. (4.6 L).

#### 2.2.15 Shelf with Mop and Broom Holders and Hooks

Shelf shall be 18-gauge, type 304 stainless steel, satin finish; 13 inches



high, 8 inches deep, 34 inches long. Unit shall have three Anti-slip mop holders with spring-loaded rubber cams that grip handles 7/8 inches to 1-1/4 inches diameter. Unit shall have four stainless steel hooks.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Surfaces of fastening devices exposed after installation shall have the same finish as the attached accessory. Exposed screw heads shall be oval. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

##### 3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

##### 3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Accessories without backplates shall have concealed fasteners. Unless indicated or specified otherwise, install accessories with sheet metal screws or wood screws in lead-lined braided jute, teflon or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

#### 3.2 CLEANING

Material shall be cleaned in accordance with manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring of surfaces.

-- End of Section --

SECTION 11060

PERFORMANCE & ARCHITECTURAL LIGHTING AND RIGGING SYSTEMS

PART 1 GENERAL

1.1 SCOPE:

Intent: This specification covers the fabrication, furnishing, delivery, and installation of the stage rigging system. The form of contract, general conditions and the project drawings are considered to be parts of these specifications.

Complete System: The Stage Equipment Contractor shall provide all items necessary for a complete, safe, fully functional system as describes herein, including all tools, scaffolding, labor and supervision, even though they may not be specifically enumerated. Any errors, omissions or ambiguities do not relieve the Contractor of this responsibility, but shall be brought to the attention of the Architect for clarification.

Work Included: The work of this section shall include, but not necessarily be limited to the following:

Trussing Systems and Supports

Architectural Dimmer Panels

Performance Lighting Dimmer Panels

Performance Lighting Control Consoles

Connector Strips, Gridiron Boxes, and SO Cables

Architectural Lighting Controls

Preset Recall Systems

Lighting Control Network

Performance Lighting Fixtures and Accessories

Emergency Transfer Switches

Acoustical Panel Attachment Points

Related Work: Related work which is not included in this section:

Gridiron, Head and Loft Block Beams, as well as all other structural steel and miscellaneous metals not specifically called out as part of this section

Galleries, Ladders and Catwalks

Stage Flooring

Electrical Connections, Service, Conduit, Boxes and Wiring of any type

Architectural Lighting Fixtures, mounts, and accessories

Audio-Visual Equipment and Systems

Fabrication and Installation of Acoustical Panels

Installation and Certification of ethernet wiring required for the operation of the lighting control system.

## 1.2 GENERAL REQUIREMENTS:

**Field Conditions:** All bidders shall fully inform themselves of the conditions under which the work is to be performed. No additional compensation shall be allowed for any labor or item the bidder could have been fully informed of prior to the bid date.

**Safety:** The systems shall conform to all applicable code requirements and shall be in conformance with industry standards of operation and practices. All materials, arrangements and procedures shall comply with applicable code requirements, allowing the users to arrange and operate a safe assembly and working environment for audience and user personnel.

**Insurance:** In the absence of more stringent requirements, the Stage Equipment Contractor shall maintain the following injury and property liability insurance coverage throughout the project's scheduled timetable, including workmen's compensation coverage for Contractor's employees. At no time throughout this project will the owner be liable for any damage, loss or personal injury claims arising out of the negligence of the Stage Equipment Contractor.

Insurance minimum limits:

General liability: \$3,000,000.00

Auto liability: \$1,000,000.00

Workers Comp.: Statutory limits

## 1.3 SUBMISSIONS

**Drawings:** Submit component and installation drawings and schedules showing all information necessary to fully explain the design features, appearance, function, fabrication, installation and use of system components in all phases of operation. They shall be approved by the Architect before beginning any fabrication, installation or erection. Such approval does not relieve the Stage Equipment Contractor of the responsibility of providing equipment in accordance with the specifications. Submittal shall include a fully dimensioned drawing indicating the location and elevation of all control consoles and stations as well as coordination drawings showing the interrelationship of stage rigging, drapery and stage lighting system. Drawings shall include, but not be limited to: plan, transverse section and elevation. Drawings should note overhead obstructions such as MEP systems and should be coordinated with the submittals of MEP trades. A full set of plans and specifications, including the Stage Equipment Contractor's approved submittal drawings shall be onsite at all times. On these drawings the Stage Equipment Contractor shall note all changes and modifications for the purpose of project coordination and the development of accurate as-built drawings.

**Catalog Cuts:** In lieu of drawings, the Contractor may submit catalog cuts for standard equipment items. These must contain full information on dimensions, construction, applications, etc. to permit proper evaluation. In addition, these must be properly identified as to their intended use. Any options or variations must be clearly noted.

**Schedule:** Prior to the commencement of the installation work, the Stage Equipment Contractor shall submit an outline of the proposed schedule and requirements for approval.

Instructions: Upon completion of the work, the Stage Equipment Contractor shall submit 3 copies of a detailed Operation and Maintenance Manual including as-built shop drawings, equipment descriptions and parts lists. The Stage Equipment Contractor shall go through the manual with personnel designated by the owner to demonstrate and explain the maintenance and operation of the systems.

#### 1.4 WARRANTY

The Stage Equipment Contractor shall provide a two-year written guarantee, on all materials and labor, against defects in materials or labor starting from the date of Substantial Completion. The guarantee shall not include: normal wear and tear, acts of God, or damages due to neglect or improper use of equipment. Any required maintenance or replacement shall be provided by the Stage Equipment Contractor within 10 days of notification by the Owner except for safety related items which shall be corrected with 24 hours of notification.

Subsequent to the expiration of the guarantee period, the Stage Equipment Contractor agrees to furnish repair and maintenance service, at the Owner's expense, within thirty days of request for such service. The installer shall maintain a service organization and be willing to enter into a service contract with the Owner after the warranty period has expired. Such contract shall be negotiated between the Owner and the Service Representative.

A complete inspection of the stage rigging shall be performed twelve months following Substantial Completion. The findings shall be provided to the Owner in the form of a detailed written report.

#### 1.5 OPERATIONAL OVERVIEW

The Specialty Lighting, Supports, and Control Systems shall provide for the needs of full ceremonial and performance functions. The lighting and lighting control system shall incorporate the latest technologies and methods, as dictated by industry-accepted performance and broadcast criteria.

The Theatrical Lighting and Rigging Systems shall represent current technology and shall facilitate future expansion of inventories and equipment purchased or rented by the Owner.

The Lighting Control Console, Dimmer Racks, and Network Nodes shall be provided by a single manufacturer who shall bear the responsibility for ensuring the interoperability of the systems and equipment provided as a whole.

The Theatrical Lighting And Rigging Systems shall be composed of the following components:

Performance Lighting Controls & Data Network

Dimmers and Transfer Cabinets

Hanging Positions and Related Rigging

Connector Strips and Circuit Distribution

Performance Lighting Fixtures

Architectural Lighting Controls

Dimming & Control Systems

Performance Lighting Controls shall be positioned in the Booth area

with appropriate interface receptacles and control wiring connecting to the Dimmer Bank and Performance Lighting Data Network. The Network shall provide control signal distribution throughout the facility for flexible connection of automated devices, controls, and control equipment via standard TCP/IP network wiring.

Lighting Control shall be provided for both Performance and Architectural dimmers via a Theatrical Lighting Control Console. The Theatrical Lighting Control Console shall be positioned in the Control Booth and shall connect to the Lighting Control Network for control of Dimmers and Automated Devices.

The Performance Lighting Control Network shall distribute control signals to and from Lighting Controls, Dimmers, and Automated Devices.

- a. Signals shall be distributed from Node to Node using standard Cat-5 wiring and TCP/IP hubs contained in 19" Auxiliary Racks.
- b. Power for Network devices shall be supported via managed IEEE802.3af compliant Power-Over-Ethernet mid-span injectors.
- c. RJ-45 receptacles, distributed throughout the facility, shall provide connection points for Nodes in the system.

The Control Systems shall be provided with a single portable, laptop computer with the following functions available simultaneously via a wired or wireless connection to the lighting control network:

- d. Real Time Monitoring and Configuration of all Dimmers and Dimmer Processors in the system
- e. Remote monitoring of video outputs provided locally by the lighting control console
- f. Remote Control of the lighting control console, including mimics of actual console displays and an independent command line.
- g. On-line configuration and monitoring of all DMX Input/Output Nodes connected to the system.
- h. On-line configuration, patching, and control of the architectural lighting controls, presets, and zones.

#### Dimmers and Transfer Cabinets

Dimmers shall provide controllable power to performance lighting and architectural lighting circuits distributed throughout the facility.

- i. Dimmers shall be of a modular type, interchangeable between slot and rack in the installation without the use of tools.
- j. Dimmer Racks shall be configured and monitored via the Portable Network PC outlined above.
- k. Dimmers shall be controlled by any one or any combination of the following devices simultaneously on an HTP or Priority basis:
  - 1) Lighting Control Console(s)
  - 2) Architectural Lighting Controls

## 3) Network PC

Emergency Transfer Cabinets shall sense loss of power in the Dimmer Cabinets, and transfer specified load circuits to an Emergency Power source in the event of loss of power to the dimming system.

## Trussing and Circuit Distribution

Hanging positions for Performance Lighting Fixtures and support of Circuit Distribution shall be provided via an array of 12" x 12" heavy duty aluminum lighting truss as shown on the project drawings.

Attachment points for the acoustical panels shall be provided by this contractor on both the trussing system and the building structure as indicated.

Connector strips shall be provided as shown on the drawings, attached to the Trussing System.

- l. The Connector Strips and Circuit Distribution shall provide individually numbered circuits throughout the facility for connection of theatrical lighting fixtures to dimmed circuits and automated devices to switched, constant power.
- m. The Circuit Distribution and Performance Lighting Fixtures shall be mounted to the Hanging Positions, which shall be suspended from the building structure and integrated with the overall architectural design for the room.
- n. Load circuits shall be run from the Circuit Distribution to individual slots in the Dimmer Cabinets in a dimmer per circuit configuration. Both the Dimmer Cabinets and the Circuit Distribution shall share a common numbering scheme to identify load circuits for the Theatrical Lighting System.
- o. Contractor shall run independent neutral conductors for each load circuit and shall label each hot and neutral conductor with the appropriate circuit number.

Lighting for the back wall shall be provided via pipe battens suspended below the roof structure perpendicular to the back wall with appropriate connector strips and circuits.

Performance Lighting Fixtures shall be of latest manufacture and shall be sufficient in quantities and configuration to light the proposed area.

Lighting Fixtures shall attach via pipe clamp to the rails of the trussing pod and shall be easily moved by the owner to the locations dictated by the demands of a given production.

Lighting fixtures shall connect to the circuit distribution via Stage Pin Connectors and flexible cables as appropriate.

Stage Equipment Contractor shall develop, document, and hang a "Rep" Lighting plot utilizing the equipment provided under this section as a part of this contract.

Followspots shall be positioned in the locations indicated on the drawings to provide flexible accent lighting for key performers and individuals as required.

Architectural Lighting Controls for routine daily use will be located throughout the facility.

Entrance controls will be two-button, single-gang devices, capable of activating one scene and off. These shall be provided in a suitable finish, and fitted with architecturally pleasing lockable covers or keyed lockout to limit access to authorized personnel.

Multi-scene controls shall be eight-button, single-gang devices capable of activating eight different scenes and off. These will be located in the Main Hall and the Control Booth, and shall be fitted with architecturally pleasing lockable covers or keyed lockout to limit access to authorized personnel, where required.

## PART 2 PRODUCTS - PERFORMANCE LIGHTING AND RIGGING SYSTEMS

### 2.1 MANUFACTURERS

Due to the highly specialized nature of theatrical lighting and rigging equipment and the safety requirements of the equipment, all equipment must be built by one of the following approved manufacturers:

Strand Lighting, Inc.: 18111 South Santa Fe Avenue, Rancho Dominguez CA 90221. Phone: (310) 637-7500 Fax (310) 632-5519

JR Clancy, Inc.: 7041 Interstate Island Road, Syracuse NY 13209. Phone: (315) 451-3440 Fax: (315) 451-1766

SSRC: 2172-A River Road, Greer SC 29650. Phone: (864)848-9770 Fax: (864) 848-3746

James Thomas Engineering, Inc.: 10240 Caneel Drive, Knoxville, Tennessee 37931. Phone: (865) 692 3060 Fax: (865) 692 9020

Lycian Stage Lighting: PO Box D, Kings Highway, Sugar Loaf NY 10981-0124. Phone: (845) 469-2285 Fax: (845) 469-5355

#### Qualifications for Trussing System Manufacturer:

The manufacturer of the Trussing System must have a product testing program, including determination of recommended working loads for products based on destructive testing by an independent laboratory and review by an independent licensed engineer. Approval to bid does not release the manufacturer from meeting this requirement.

The manufacturer of the trussing system and dimming & control systems must have a quality management system registered to the ISO 9001:2000 standard. Approval to bid does not release the manufacturer from meeting this requirement.

The Manufacturer of the Trussing System shall provide sealed engineering reports and drawings detailing trussing equipment and systems, including a stamped and sealed drawing of the assembled system as a whole. All loads shall include 20% overload factor for dynamic effects.

### 2.2 SUBSTITUTIONS

In no case will materials of lesser design or workmanship be acceptable. Any Stage Equipment Contractor proposing to use a substitute material or item of equipment must guarantee the suitability of the recommended substitution. Approval of a manufacturer does not guarantee acceptance of equipment.

Requirements for Approval: Other equipment manufacturers seeking

acceptance must submit the following information at least 2 weeks prior to the bid opening date. Approval of manufacturers will be by addenda. Failure to submit any of the required information will automatically disqualify the manufacturer from consideration of approval.

Evidence that the manufacturer has been in business for a minimum of ten years manufacturing stage equipment.

A listing of 10 equivalent installations including:

- a. Name, address and telephone number of Owner
- b. Name, address and telephone number of Architect
- c. Scope of work

A detailed written description of the manufacturer's operation including facilities, financial capabilities and experience of key personnel.

A statement from an insurance company indicating that the manufacturer carries a primary product and general liability insurance of \$2,000,000 each and excess liability of \$10,000,000.

A product testing program including determination of recommended working loads for products based on destructive testing by an independent laboratory and review by an independent licensed engineer. Manufacturers seeking approval must submit details of their test program and methods along with the names and telephone numbers of the independent test lab and independent licensed professional engineer performing the product testing and review.

A certificate showing the registration of their quality management program to ISO 9001:2000.

Appropriate manufacturer's literature, catalog information, cut sheets and product data sheets sufficient to permit the architect or engineer to make a meaningful and informed decision to accept the substitution.

A detailed statement indicating paragraph by paragraph and drawing by drawing wherein the equipment to be offered complies with or deviates from the equipment and systems described by these specifications and the project drawings.

ALTERNATE PROPOSALS: While the components, units and arrangements described herein and shown on the drawings to indicate specific details for the realization of the stage equipment systems, bidders may propose alternate details and components that will fulfill the functional parameters of the envisioned system.

When submitting an alternate proposal, bidders shall submit a complete set of specifications and drawings, not less detailed than these and following the same general outline, together with a detailed statement indicating paragraph by paragraph wherein the equipment to be offered deviates from specifications included in this bid request.

Where alternate proposals are offered, they shall be submitted with the amount to be added or deducted from the base bid which is required from all bidders.

## 2.3 GENERAL

Standards:

Materials shall conform to the following ASTM and ANSI standard



## specifications:

- a. A-36: Specification for structural steel
- b. A-47: Specification for malleable iron casting
- c. A-48: Specification for gray iron casting
- d. A-120: Specification for black and hot-dipped, zinc-coated (galvanized) steel pipe for ordinary use
- e. B18.2.1 & 2: Specification for square and hex bolts and nuts

In order to establish minimum standard of safety, the following factors shall be used:

- f. Cables and fittings: 8:1 Safety Factor
- g. Cable bending ratio: Sheave tread diameter is 30 times cable diameter
- h. Tread Pressures: 500 lbs. For cast iron, 900 lbs. for Nylatron, 1000 lbs. for steel
- i. Maximum fleet angle: 112 degrees
- j. Steel: 15 of yield
- k. Bearings: Two times required load at full speed for 2000 hours
- l. Bolts: Minimum SAE J429 Grade 5 (ISO R898 Class 8.8), zinc plated
- m. Motors: 1.0 Service Factor
- n. Gearboxes: 1.25 Mechanical Strength Service Factor
- o. Listing and Labeling: Where applicable standard have been established, equipment shall be "Listed and Labeled" by a "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7. The terms "Listed and Labeled" shall be defined as they are in the National Electrical Code, Article 100.
- p. NEC Compliance: National Electrical Code (NFPA 70)
- q. NEMA Compliance: National Electrical Manufacturers Association
- r. ANSI Compliance: Provide electric lamps which comply with ANSI construction and rating standards.

Materials: All materials used in this project shall be new, unused and of the latest design. Re-furbished and obsolete materials are not permitted.

## Fabrication:

The mechanical fabrication and workmanship shall incorporate best practices for good fit and finish. There shall be no burrs or sharp edges to cause a hazard nor shall there be any sharp corners accessible to personnel.

All moving parts shall have specified tolerances. Sheaves shall run plumb and true and shall not scrape housings.

All equipment shall be built and installed to facilitate future maintenance and replacement.

Finishes:

Paint shall be the manufacturer's standard finish and color except as noted.

All turnbuckles, clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted.

Recommended Working Load: this specification calls for minimum recommended working loads for many hardware items. The manufacturer's recommended working load is the maximum load which the manufacturer recommends be applied to properly installed, maintained, and operated new equipment. Manufacturer's recommended working loads shall be determined by calculations by a Licensed Professional Engineer and destructive testing by an independent testing laboratory. These calculations and reports shall be available for review.

## 2.4 LIGHTING CONTROL NETWORK

### Overview

#### General

- a. The Lighting Control Network shall provide data distribution over a TCP/IP ethernet Network. Systems using proprietary formats or formats other than TCP/IP shall not be accepted.
- b. Connections shall be made between consoles, computers and SN series nodes over a standard Ethernet distribution systems using 10/100BaseT wiring, Wireless 802.11b Ethernet, or a combination of both. All installations shall conform to established Ethernet wiring practice and installation and shall be performed by contractors qualified to do this type of work. All wiring shall be tested for full bandwidth operation to the appropriate IEEE standard.
- c. Installing contractors shall provide full test and certification documents on all network wiring.

#### Capacities

- d. The Network shall provide DMX routing and patching for up to 18,432 DMX addresses and DMX data may be output in a variety of output formats to any DMX node in the system. DMX input, routing and output shall be specifically supported on the system from multiple sources and locations.
- e. The system shall support multiple consoles, computers, file servers, printers with discrete command lines and control. The ShowNet system may support multiple facilities within a complex.
- f. System configuration shall be via Strand ShowNet Windows software or where applicable any Web browser and permit simple point and click connection between Consoles and Nodes, Consoles and Consoles, and Consoles and File Servers. The software shall permit complete user

flexibility allowing the system operator to define DMX data groups, Node Names and console names for easy identification. Each node shall have a specific user selectable IP address. Systems that do not support simple Windows operation shall not be acceptable.

- g. Outputs may be created from multiple overlapping sources with up to 3 levels of patch priority.
- h. DMX data streams may consist of any range of 512 numbers from the available system capacity allowing complex number ranges to be created using "and" and "thru" command structures.
- i. All configuration data for each Network device shall be held at the device and system operation shall not require continuous on line operation of the Network configuration software.
- j. The following interfaces shall be provided on each network:
  - 1) Remote Handheld Control (wired and wireless)
  - 2) Serial Data (Communication with and configuration of the Dimmer Rack Processors and Architectural Control Processors)
  - 3) Multiple Remote Printers
  - 4) Universal DMX512 Dimmer Mux up to 18,432 outputs (36 standard DMX Universes)
  - 5) Remote Faders and Switches

#### Operational Features

- k. The video monitor outputs at any video node shall be able to monitor the video output of any 300 or 500 series console connected to the Ethernet with Networker software. Each Video node shall have discrete display access to any console and any console display.
- l. Each Node shall control up to 1024 DMX addresses, within the confines of an up to a 36 DMX (18,432 DMX addresses) "universe" system. The specific DMX data input or output by the Node shall be freely configurable by the user. Duplicate outputs of DMX lines (DMX splitter) and discrete outputs shall be fully supported.
- m. Any number of DMX lines may be configured with any length up to 512 addresses as long as the total does not exceed 18,432. Any range of DMX addresses may be selected for each feed and may be any set of 512 numbers from the total available on the network. Numbers may be selected in any order and the use of "and" plus "thru" commands shall be supported with ShowNet Professional software. Multiple sources may be combined on any node output and a priority may be assigned to each source. Each DMX output on each node may have its own label and start address for ease of use.
- n. DMX ports shall be configurable for either input or

output. Multiple DMX signal routing patches and multiple facilities shall be specifically supported and limited only by the file storage capacity of the computer with ShowNet software installed.

- o. The Network shall support Parallel and Remote operation of 300 and 500 series control consoles with one another as well as with Mac OSX and Windows XP Portable Computers equipped with a Designer's Remote Software Key.
- p. The Network shall support Tracking Back up operation of 300 and 500 series control consoles.
- q. File transmission, synchronization and access to File Servers using Microsoft XP server software shall be specifically supported.
- r. All Network configuration information shall be available as a system printout. Specific printouts shall be available to assist in the addressing of DMX devices on the network.

#### Auxiliary Racks

##### General

- s. Auxiliary Control Racks Shall be provided as shown on the project drawings to connect and power the various components of the Lighting Control Network.
- t. Furnish and install a fully functioning Performance Lighting Ethernet System. The System shall be installed in accordance with the latest ESTA and IEEE 802.3 standards and the Control Console Manufacturer's Requirements.

##### Ethernet Hubs/ Patch Panels

- u. Provide hubs/ switches and patch panels of a high quality from a company with (5) five or more years of experience manufacturing the equipment.
- v. All Hubs/ Switches shall be dual speed capable of operating standard and fast Ethernet Protocols
- w. Label hubs and patch panels with the location of the field boxes and as labeled in the box schedules.
- x. Provide proper quantity of Cat-5 patch cables to patch all network receptacles and devices to hubs/ switches.
- y. All Hubs/ switches shall be fully compliant with the IEEE 802.3 Power over Ethernet Standard, and shall provide power over the network to all network receptacles and devices.
- z. Provide Fiber Optic ports and converters as required to connect Network wiring that exceeds 100m overall run.

##### UPS Power Devices

- aa. Provide UPS Power Devices of a high quality from a company with (5) five or more years of experience manufacturing the equipment.

- bb. All equipment in the Auxiliary Racks shall be powered via a UPS located in the rack.
- cc. UPS Devices shall have a rating of not less than 1500VA with battery backup.
- dd. UPS Devices shall be monitored and configured via the Lighting Control Network.

Rack - Physical

- ee. Provide 19" Equipment racks as required to accommodate equipment required per rack
- ff. Equipment Racks shall be provided with removable, hinged front and rear doors. Doors shall be of sufficient depth to allow proper cooling and connection of equipment.
- gg. Provide Blank Plates as required to fill empty spaces in the equipment rack.

Quantities

- hh. Furnish and install Dimmer Room Auxiliary Rack including the following equipment:
  - 1) (1) 16 Port Managed Ethernet Hub
  - 2) (1) 16 Port Managed Mid-Span 802.3af Power Injector
  - 3) (1) 16 Port Patch Panel
  - 4) (32) Patch Cables
  - 5) (1) 1500VA UPS
  - 6) (1) Fiber Optic Media Converter
  - 7) (1) Equipment Rack, wall mount with hinged rear panel.
  - 8) (1) Lot blank panels as required
- ii. Furnish and install Control Booth Auxiliary Rack including the following equipment:
  - 1) (1) 24 Port Managed Ethernet Hub
  - 2) (1) 16 Port Managed Mid-Span 802.3af Power Injector
  - 3) (1) 24 Port Patch Panel
  - 4) (48) Patch Cables
  - 5) (1) 1500VA UPS
  - 6) (1) Fiber Optic Media Converter
  - 7) (1) Equipment Rack, Full Height
  - 8) (1) 4-Space Locking Drawer
  - 9) (1) Linksys WAP-11 802.11b Access Point
  - 10) (1) Lot Blank Panels as required

Dual Port DMX Ethernet Node

General

- jj. The DMX Node shall be an intelligent, wall mounting, Ethernet node providing DMX and Reporter Dimmer data distribution.
- kk. Connections shall be made between nodes over standard Ethernet distribution systems using 10BaseT or 100BaseTX wiring or a combination of systems. Each Node shall be supplied with an integral LCD display for labeling and status monitoring. It shall incorporate an external low voltage power supply generated by a standard power supply or by an Ethernet Hub conforming to the IEEE802.3af standard. It shall be designed and manufactured by a company operating a quality system approved to ISO9001.

#### Physical

- ll. The Node electronics shall be supplied with a back box suitable for flush or surface mounting and finished in powder coat blue. There shall be no visible fasteners.
- mm. The Node shall be designed for use in Power over Ethernet applications.
- nn. The Node shall feature a total of 2 XLR connectors on the front panel.
  - 1) There shall 2 DMX512 (512 dimmers per port, selectable In/Out), 5 pin female XLR connectors standard.
  - 2) It shall be possible to factory configure the connectors to be male or female and 5 pin to meet project requirements.
- oo. An LCD display shall be provided to dynamically label each node and receptacle. The display shall be user configurable using a standard Web Browser or Strand ShowNet software.

#### Electronics

- pp. The node processor shall be an industry standard 32-bit microprocessor with integral 10/100BT Ethernet support.
- qq. Configuration of the Node shall be stored in non volatile memory.

#### Operational Features

- rr. The Node shall be remotely configured via the network system wiring using either Strand ShowNet software or a standard Web Browser.
- ss. The Node shall control up to 1024 DMX channels, within the confines of an up to 36 DMX "universe" system. The specific DMX channels input or output by the Node shall be freely configurable by the user.
- tt. Outputs may be created from multiple overlapping sources with up to 3 levels of patch priority.

- uu. All ports may be configured as a DMX input or output. Ports may also be configured as an RS 485 data input onto the network to support dimmer status reporting.

#### Environmental

- vv. The ambient operating temperature shall be 0° to 40°C (32° to 104°F).
- ww. The storage temperature shall be -40° to 70°C (-40° to 158°F).
- xx. The operating humidity shall be 5% - 95% non-condensing.

#### Standards Compliance

- yy. EMC emissions to EN50081-1, EN55014; EMC immunity to EN50082-1, IEC1000-2-2; Safety: EN60950, EN60439 Part 1 (also part 12 BS5486); design & build: ISO9000, UL1950. Ethernet IEEE
- zz. The Node shall be CE UL & cUL listed.

#### Furnish and install the following:

- aaa. (15) Strand Lighting #65110-P, Pipe-Mounted Portable Dual DMX Port Ethernet Nodes configured for Power Over Ethernet and each provided with (1) Pipe Clamp (Altman #510 or equal) and appropriate mounting hardware.
- bbb. (15) 25' Ethercon Patch Cable

### 2.5 LIGHTING CONTROL CONSOLE

#### Hardware Overview

The lighting control console shall be a Strand Lighting 520i series lighting control console. All controls shall be microprocessor based and specifically designed to provide complete control of stage, studio and entertainment lighting systems.

An open architecture system using non-proprietary interfaces to permit future upgrades shall be used.

All equipment shall be designed and manufactured by a company operating a quality system approved to ISO9001. It shall be UL & cUL listed.

Systems that do not provide the following capabilities shall not be acceptable.

#### Capacities

- a. The console shall provide direct control of up to 8192 DMX512 devices via a maximum of up to 6000 intensity and 6000 attribute channels. Attributes shall be units of control dedicated to color scrollers and moving lights. For maximum flexibility in configuration and future upgradability console hardware and software shall be available separately.
- b. A maximum of 2000 cues, 24 submasters x 6 pages, 1000 groups, 600 effects, 3000 macros and 2 patches may be stored in internal non-volatile memory and archived to 3.5" MS-DOS formatted floppy disks. Multiple shows and show file Back ups shall be stored on an internal 2GB

hard disk. Industry standard Intel Pentium II micro-processors shall be employed.

#### Control Interface

- c. The main controls shall consist of a numeric keypad, dedicated control keys, 6 context sensitive soft keys with on panel graphical LCD labels, channel control wheel, large 50mm Tracker ball for moving light positioning and 4 rotary controls for adjusting moving light attributes. Control commands shall be accepted as either command line or direct entry as a user option.
- d. Two playbacks shall be provided each with twin faders, illuminated go button, dedicated keys and graphical LCD labeled soft keys. Interaction between each playback shall be user programmable as highest level or latest action takes precedence. Each playback shall operate in automatic, manual fade or manual time modes executing cues while following links, loops and subroutines. The system shall support two fully independent cue sheets, one for each playback. A dedicated control wheel shall provide rate override of fades or effects. Tracking and Cue Only modes of operation shall be supported. A total of 200 simultaneous fades will be supported.
- e. 6 pages of 54 fully overlapping submasters shall each be provided with 60mm faders, a bump button and loaded & active LED's. Each submaster shall be individually programmable as normal, inhibitive or independent with programmable split up/down fade times, attribute times, and text labels recordable per page.
- f. Supermaster functions may be assigned to the submasters, providing mastering of effects, submasters, audio level, midi rate, flash level and DMX input.
- g. Up to 2 high resolution monitors ( expandable to 4 with optional dual video card) shall be provided for the display of levels, cues, submasters, groups, effects, set-up & patch screens selectable from direct on panel keys. On panel graphics LCD shall indicate current cues, submaster, group, effect, channel and level.
- h. Attributes shall be excluded from inappropriate masters and shall combine on a latest action takes precedence basis.
- i. An optional detachable alpha numeric keypad for text labeling and software and hardware for dimmer reporting, designer's remote, remote faders and switches, remote video, MIDI & Ethernet networking shall be available.

#### Software System Overview

Operating Software updates shall be user installable from 3.5" floppy disks.

English, French, German, Spanish, Swedish, Swiss, Russian, Italian & Dutch language support shall be built-in as shall on-screen help.



Tracker, Networker, CommuniquéPro, Reporter, and Server Application Software shall be included.

Channel and attribute capacity shall be software upgradable at any time to the maximum capacity of the console.

Console Interface List: the following console interfaces shall be provided:

VGA Output 1

VGA Output 2

Keyboard

Serial COM1 for Digitizer interface

Printer (Parallel LPT1)

Remote Control (Serial COM2 ) for Mouse interface

Universal DMX 512 Dimmer Mux I/O 1

Universal DMX 512 Dimmer Mux I/O 2

Universal DMX 512 Dimmer Mux I/O 3

Universal DMX 512 Dimmer Mux I/O 4

Dimmer Output D54

Dimmer Output AMX192

Auxiliary (Remote Dimmer Supervisor)

Auxiliary (Auxiliary System)

Auxiliary (Remote Control)

Remote Faders and Switches

MIDI Input

MIDI Through

MIDI Output

Audio Input (Effects and SMPTE)

Mains Power Input

Mains Power Output

Ethernet 10BaseT (Shownet Network Lighting Control)

Ethernet 10Base2

Console Physical & Electrical

The console controls and electronics shall be desk top mounting and shall use an Intel Pentium II micro-processor.

The console shall be constructed of galvanized sheet steel and aluminum extrusion with flame retardant ABS controls.

The console shall incorporate a universal 90-120v / 220-240v power supply.

Operational Environment

The acceptable ambient operating temperature shall be 0° to 40°C (32° to 104°F) and the ambient storage temperature shall be -40° to 70°C (-40° to 158°F)

The acceptable operation location shall be the equivalent of a good office environment, without excessive dust.

Acceptable humidity levels for operation shall be 5% - 95%, non-condensing.

#### Standards Compliance

All equipment shall be designed and manufactured by a company operating a quality system approved to ISO9001.

The console shall be UL & cUL listed and CE Labeled.

#### GeniusPro/Lightpalette Operating Software

##### Operating System

- j. The system software shall be a true 32 bit multi-tasking operating system. Programs using a 16 bit operating system shall not be acceptable. The software shall be user selectable for Lightpalette Tracking style operation or Preset/Whole cue operations using GeniusPro software. Either operating mode shall be user selectable in set up.

##### Channel Control

- k. Selection: Channel control lists shall be composed of any combination of control channels, cues, submasters, effects or groups using the +, -, Thru & Thru-on syntax. Any one selection shall be capable of being manipulated for level, color scroller & moving light control without the need to re-select.
- l. Intensity Control: Intensity levels shall be set using the @ key and adjusted using the level wheel. Proportional or shaft mastering of selected channel levels on the wheel shall be a user option as well as sensitivity of wheel response. Context sensitive soft keys with on panel graphics LCD labels shall be provided for Full, DMX level, +5%, -5%, Off & Copy From. An On key with per channel user definable levels shall be provided as shall a Remainder Dim key. Channel fade operation shall be a standard feature allowing the timed fade of any channel or list of channels.
- m. Color Frame Control: Full color frames shall be selected using the @ATT key followed by the frame number. Part frames may be adjusted using the rotary control wheels. Dedicated displays shall be provided to show color frame attributes of control channels. Preset focus groups shall be available to permit the recall of specific colors from scrollers or moving lights with different configurations. Selecting the @ATT key shall provide additional softkey access to Position, Beam, Color and other moving light attributes.
- n. Commands: Command entry shall be user selectable between command line (e.g. RECORD CUE 1 \* [enter]) and direct

entry (e.g. CUE 1 RECORD). Omitted parts of abbreviated commands shall be displayed on the command line. The text label associated with cue, group, effects & attribute page numbers shall be displayed on the command line.

#### Cues

- o. The console shall default to tracking cue recording (Lightpalette) or preset recording (GeniusPro). Q Only operation shall be available as a user selected option for Lightpalette and Tracking shall be an option for GeniusPro operation..
- p. Each cue may have split fade & delay times, a wait time, link & loop parameters, calls for macros & effects, a text label and may be assigned to either playback. Fade times of 1/100<sup>th</sup> of a second shall be supported.
- q. Cue zero shall always be an intensity only blackout cue.
- r. Cues shall have up to 12 parts.
- s. Intensity only and attribute only cues and parts shall be supported.

#### Recording & Updating

- t. Cues, groups, submasters, macros, & effects shall be recorded or updated from the keypad. Channel lists may be copied between cues using the Update command key.
- u. It shall be possible to automatically replace channels with others using the Automod command. This command will allow users to replace key luminaires from a list of programmed substitute channels.

#### Playbacks

- v. Two playbacks shall be provided each with twin 100mm faders, illuminated Go button dedicated stop/back, cue & load keys and context sensitive soft keys with on panel graphical LCD labels. Interaction between each playback shall be user programmable as highest level or latest action takes precedence operating from either a common or separate cue sheet (sequence list). Each playback shall operate in automatic, manual fade or manual time modes executing fades while following links, loops and subroutines.
- w. A dedicated control wheel shall provide rate override of fades or effects.
- x. Q Only and Tracking modes of operation shall be supported.
- y. Up/Down selection keys shall permit individual fade parts to be selected and manually faded.
- z. Channels may be partitioned to individual playbacks for discrete control.
- aa. Auto-Preheat shall provide an optional automatic means of fading intensity channels to a user defined

preheat level before the channels are needed without the need to record extra cues.

#### Effects

- bb. Up to 600 text labeled effects containing up to 99 steps may be stored with each show. Up to 30 simultaneous effects may be played back from cues, submasters or macros.
- cc. Chase and build effect types shall be supported as shall forward, reverse, bounce and random directions.
- dd. Levels and attributes shall be recorded in every step or shall be randomly generated or inverted or alternatively normal and inverted every cycle.
- ee. Discrete in, dwell, out and attribute fade times shall be programmable on a per step basis. Default in, dwell, out & attribute fade times and low & hi levels shall be provided per effect. Step times of 1/100<sup>th</sup> of a second shall be supported.
- ff. Effects shall be chain-able and have overall fade in and out times.
- gg. Step control shall be timed, manual or, with CommuniquéPro, MIDI, SMPTE or Audio controlled. Effects may be programmed to start or stop from a cue, run a defined number of cycles, run for a defined period of time or stop only after the last step has completed. Effects may also be loaded and run from submasters.
- hh. Effects may be programmed as Last action or Highest takes precedence pile on events.
- ii. Direct control of a running effect type & direction shall be provided from a set of effects playback keys. The rate wheel may be used to adjust the step or fade in and out times.
- jj. Modifications to running effects may be returned back to the effects memory for re-recording.

#### Cue, Submaster and Effect Previews & Cross Reference Screen

- kk. Cue, submaster and effect preview modes shall be supported to permit blind changes to be made to these entities using channel control syntax.
- ll. A Cross Reference screen shall provide an alternative view of cues by showing levels recorded in a range of cues.
- mm. Changes may be tracked or restricted to one cue using the Cue Only soft key.

#### Submasters and Supermasters

- nn. 6 pages of 54 fully overlapping submasters shall each be provided with 60mm faders, a bump button and loaded & active LED's.
- oo. Each submaster shall be individually programmable as normal, inhibitive, exclusive or independent with

programmable split up/down fade times, attribute times, and text labels recordable per page.

- pp. Supermaster functions may be assigned to the submasters, providing mastering of effects, submasters, audio level, midi rate, flash level and DMX input.
- qq. Bump buttons may be individually enabled, disabled, latching or in solo mode.
- rr. Submaster pages shall be automatically held on a per submaster basis until a submaster leaves the home position.
- ss. Submasters shall be loadable with the contents of cues, groups, other submasters or channel lists. Effects may be loaded and run from submasters.

#### Groups

- tt. A maximum of 1000 Groups may be recorded for fast recall of commonly used stage looks. Groups can be independently recorded or directly recorded from the stage output. The first 750 groups may be used as preset focus groups. Cues recorded using preset focus groups may be easily edited and changed by simply updating the focus groups.
- uu. Each group may be assigned a text label.
- vv. Attribute groups can also be created to allow grouping of luminaire functions.
- ww. The console shall include the following special groups: Handheld 1 through Handheld 4 "On" level, Console "On" level, Display Group 1, Display Group 2, Preheat group, Playback Groups (2), "@ attribute" Color attribute recall groups (1000), Console Groups.

#### Display Formats

- xx. User programmable channel display formats shall be provided to show channel levels, colors, and attribute information. Formats shall be provided to mimic Strand LP90, Gemini, Galaxy & Genius displays. User programmable channel formats shall be provided to show channels in use, defined channels or active channels.
- yy. Automatic paging and shifting between standard and attribute formats shall be supported with Tracker software.

#### Patch

- zz. Two proportional soft patches shall be provided with provision to edit and switch between either in performance.
- aaa. Dimmers may be profiled, set with a non-dim trigger value, or unpatched at a level.
- bbb. Tracker software shall incorporate a library of luminaires to simplify patching.
- ccc. Patch displays shall be ordered by channel or by mux

output.

#### Profiles

- ddd. Up to 99 text labeled profiles shall be supported per show. Point resolution shall be a maximum of 255 steps.
- eee. Profiles may be applied to dimmers or up/down fades in cues or parts.
- fff. Intermediate levels between any two points shall be automatically calculated when defined.
- ggg. Profiles shall include a graphical editing screen.
- hhh. A profile learn mode shall be available to allow on operator to run a fade manually and have the console "learn" the fade and store it as a profile.

#### Set-up

- iii. Comprehensive set-up screens shall be provided to configure external communications and operation of the console.

#### Macros

- jjj. Up to 3000 macros each of up to 120 key presses may be recorded
- kkk. Macros may be activated by number, direct action soft key, from a cue or submaster, external switch contact, remote control, console power-up or at pre-programmed times.
- lll. Macros numbered above 1001 may be used to map control areas for an optional digitizer panel to provide graphical "one touch" access to a wide range of console functions including access to all moving light functionality and preset focus areas. A full set of programming aids shall be available to create templates for use with digitizers.

#### Archive

- mmm. Show archive shall be supported to floppy and hard disk or file server (with included Networker software). File server may be a designated console or PC.
- nnn. The archive screen shall provide a means to select the current show from the hard disk or file server (with Networker) and to copy a show (or any part of a show) to or from a floppy disk, hard disk or the file server (with Networker).
- ooo. Shows shall have text labels and a time and date stamp.
- ppp. 10 Back up files shall be created for each show file stored on the hard disk.

#### Printing

- qqq. The system shall support a wide range of dot matrix and HP compatible laser and ink jet printers. Color printing shall be specifically supported.

rrr. The following printouts may be requested: Patch, Cues, Groups, Subs, Profiles, Macros, Fixtures, Channels in Use, Channels not in use.

sss. It shall be possible to request printouts in Portrait or landscape mode and paper sizes up to 11 X 17.

ttt. All printouts may have user definable ranges.

#### Peripherals

Support shall be provided, as standard, for the connection of a handheld remote control and several different types of printer including HP LaserJet & InkJet and compatibles.

Additional peripherals, such as remote video, designer's remote stations, and remote DMX stations shall be supported through the integration of additional optional equipment.

#### Auxilliary software and Equipment

##### Channel Capacity Software Upgrades

uuu. Channel and attribute capacity shall be upgradable via software to the maximum capacity of the console in 50 or 200 channel increments.

##### Tracker Application Software

vvv. The Tracker application software package shall be a standard enhancement to the GeniusPro/Lightpalette software package. It shall provide intelligent control of any DMX moving lights as detailed below:

www. All attributes of a moving light fixture (intensity, color, gobo, focus, X-Y position, effects, CMY, RGB, etc.) shall be accessed by typing one channel number.

xxx. Dedicated physical controls for moving lights shall be provided in the form of a tracker ball for X-Y positioning, 4 rotary controls for automated fixture attribute manipulation, 7 dedicated direct action macro keys and 3 soft keys for x-y lock & rotary page selection.

yyy. Individual attributes shall also be selected from context sensitive soft keys with on panel graphical LCD labels showing attribute names.

zzz. Displays shall be provided which show all attributes of a channel, and shall be capable of automatically switching between condensed intensity only or intensity and color scroll or full attribute displays.

aaaa. Attributes shall be excluded from inappropriate masters and normally operate in latest action takes precedence fashion within submasters, playbacks and effects.

bbbb. When attributes and levels are recorded in a submaster the levels shall be mastered by the fader but the attributes shall go to their recorded value in the recorded time in a latest takes precedence basis to ensure that scenes played back on submasters can be

faded in and out with recorded colors and positions. When attributes only are recorded into a submaster, the attributes values within the submaster shall be mastered by the fader and operate in a highest takes precedence basis to allow attributes to be manual adjusted.

cccc. Cue tracking shall be supported for attribute channels.

dddd. Channel and attribute cross reference screen shall be provided for blind plotting and viewing.

eeee. Auto-Move-When-Dark shall provide an optional automatic means of moving fixtures to the next required position (pan, tilt, color, gobo, etc.) after the previous fade has completed and when the fixture intensity is zero without the need to record extra cues.

ffff. A library of common moving fixtures with text labels shall be provided to facilitate fast patching. Additional fixtures may be added to the library by the user at any time. Full user patching of all attributes shall also be provided to allow fixtures not currently included in the library to be used.

#### CommuniquéPro Application Software

gggg. The CommuniquéPro application software package shall be a standard enhancement to the GeniusPro/ Lightpalette software package. It shall provide an range of remote control facilities as detailed below:

hhhh. Twelve external (+10v) analogue inputs shall be provided which may be configured as remote submasters or macros. A +10v supply shall also be provided from the console.

iiii. Up to three sequential bytes per user programmable macro trigger shall be provided for MIDI & RS232.

jjjj. A single DMX-512 input shall be shall be available for patching direct-to-output dimmers or for assignment to a supermaster so that incoming 'dimmer' levels are interpreted as control channels up to the maximum channel size loaded. Supermasters may be configured to master either type of DMX-512 input.

kkkk. Full remote control of all console keys shall be available by RS232 character strings.

llll. A programmable RS232 or RS 485 remote cue go output shall be available for triggering external devices. Output format shall be standard ASCII format for interfacing to a wide range of external devices and computers..

mmmm. The following MIDI functions shall be provided :

- 1) User programmable MIDI channels 1 to 16. MIDI note on / note off for bumping submasters.
- 2) MIDI note on / note velocity for flash level.
- 3) MIDI configurable general purpose controllers.



- 4) MIDI Show Control (MSC) : Go, Go Cue X, Load Cue X, Stop, Resume, User Macro Fire, Reset. MIDI for tracking backup or slaving consoles together. MIDI Control Change message for all controls.

nnnn. The console shall support cue execution via SMPTE time code events. A SMPTE input shall be supported on the consoles audio input connector.

#### Networker Application Software

oooo. The Networker application package shall consist of Ethernet network enhancement software for GeniusPro/Lightpalette and SN100 using the built in Ethernet port on the console.

pppp. It shall support industry standard 10BaseT or 10Base2 cables, connectors, hubs, concentrators and bridges. It shall support the following features:

qqqq. Remote DMX

- 1) Up to 2 remote DMX ports at each SN110 node shall be user configurable as inputs or outputs.
- 2) DMX distribution between any SN110 series node shall be supported without routing via a console. A total of 99 nodes shall be supported.

rrrr. Remote Video: All console VGA outputs shall be available at a Laptop Computer equipped with a Designers Remote Software Key.

ssss. Remote Connections

- 1) Printouts may be redirected over the network to any compatible printer connected to any other console or SN100.
- 2) Up to 4 handheld remote controls may be connected to any port on any console or SN100.
- 3) Faders and switches on any SN100 may be used to trigger macros or master faders on any console on the network.

tttt. Tracking Backup: Two consoles or a console and a 510i Back up processor identically configured may be operated as main and full tracking backup.

uuuu. Multi-user Operation

- 1) Multiple consoles or a console and a Designer's Remote PC may be operated as main and designer's remotes. Full control interaction and multiple user log ins shall be supported. Remote consoles shall have their own discrete video displays and command lines.
- 2) The system shall also support channel partitioning by console or PC allowing two or more users to write to a common cue base with separate channel lists. This shall permit a system that shall allow one operator to create fixed luminaire lighting cues while another

operator is focusing moving lights. The system shall then be recombined to run a show from a single console.

#### GeniusPro/Lightpalette Off-Line Editor Software

vvvv. All facilities of the console, including patching, channel control, playbacks, submasters, effects & set-up shall be supported on the off-line editor.

www. Show files shall be portable between all configurations of Genius Plus, Lightpalette and off-line editor.

#### Reporter software

xxxx. The system shall provide dimmer and rack status monitoring when used with CD80SV dimmer racks. Basic monitoring shall include rack temperature, fan operation, DMX status for all racks.

yyyy. Advanced monitoring shall be available for all systems employing CD80SV status reporting dimmer modules. The system shall monitor and report on load status including load change, load loss, current connected load (load learning), circuit breaker trip and dimmer temperature. Dimmer errors shall be reported on the system message area adjacent to the command line, on screen at the affected channel and through a detailed report screen and log.

zzzz. Reporter software shall also provide access to the creation and editing of dimmer rack back up presets. Each of the 99 presets shall be fully accessible for record and playback including the setting of fade times.

#### Wireless Handheld Remote Focus Unit

aaaaa. The Wireless Handheld Remote shall consist of a Compaq iPaq H3850 Pocket PC running Windows CE and Microsoft Pocket PC2002 Software. The remote shall be complete with an 802.11b wireless network card, PCMCIA Expansion Pack, Docking Cradle, Stylus, and power Cord. The Remote shall be provided with (1) 802.11b wireless access point (Linksys WAN Series or equivalent).

bbbbb. Consoles shall support up to (4) wireless remotes per console

cccc. The remote shall support channel addressing and direct dimmer access as well as Cue recall and playback.

ddddd. The remote shall support configuration of SN110 Shownet Nodes using Pocket Internet Explorer Software.

eeee. All equipment shall be designed and manufactured by a company operating a quality system approved to ISO9001.

#### VGA Color Video Monitors

ffff. The console and SN nodes shall support computer industry standard VGA color video monitors.

## Printer

ggggg. The system shall support a variety of computer industry standard printers, including, but not limited to, LaserJet, DeskJet, Color DeskJet, Epson FX, and IBM ProPrinter.

## ASCII Keyboard

hhhhh. Color coordinated Mini Keyboards, and Full Sized Keyboards, both computer industry standard shall be available.

## Dust Covers

iiiii. High quality dust covers shall be available for the console and its monitors.

## Digitizer

jjjjj. A digitizer shall be available for use as a programming tool. A variety of sizes shall be supported using the systems 3000 macros to define working areas on the digitizer tablet. Typical applications including selecting and programming fixed luminaires and addressing automated luminaires and color changers.

## Included Furnishings

The control console shall be supplied with:

kkkkk. Power cord  
lllll. (1) 15' Ethernet Control Cable  
mmmmm. (1) UPS/ Power Conditioner  
nnnnn. (2) 17" LCD Monitor Panels  
ooooo. (1) Mini-Keyboard  
ppppp. (1) Dust Cover  
qqqqq. (1) Wireless Handheld Remote with software  
rrrrr. Operations manual with CD ROM providing extended software and documentation. A fully interactive tutorial plus a back up copy of all system software shall be included with each CD ROM. In addition the operations manual and tutorial shall be available on the world wide web.

## Quantities

Furnish and install (1) Strand Lighting #95982 520i Lighting Control Console with (1000) intensity channels and (500) attributes, including Reporter, Lightpalette, Server, WiFi, Networker, and CommuniquePro software.

## 2.6 CONSOLE REMOTE SOFTWARE

## General

The Strand Designer remote Notebook computer and USB drive assembly shall allow users to connect to any Strand Lighting 300 or 500 series console over a ShowNet Ethernet network and receive console video displays.

Each system shall include Strand Designer Remote Software and complete console operators manuals in both HTML and PDF format.

The system shall include built in WiFi wireless Ethernet and shall allow the operator to access the lighting system from any location in the theatre or studio.

#### Operational Features

The system shall allow a user to connect to any Strand 300 or 500 series console as a remote user and receive console video display information. Each console display shall appear in a separate window and up to four windows/screens may be displayed. The standard display shall be two windows/screens, four screens shall be available only with consoles equipped for four displays.

Users may log in using one of two modes for system access. Monitor mode shall allow a user to view screens only. The full log in mode shall allow the operator full control access to the lighting system and support record and playback operation as well as level setting.

A simple set up option shall be provided to allow a user to select one of three on screen buttons for instant access to any control console within a system. Console connections shall be made by entering the IP address of the desired console, the user number (1-5) and the desired number of console display windows.

Each 300 console shall support one remote user. All 500 series consoles with I build software shall support up to 4 remote users.

The system shall support both wired and wireless Ethernet access allowing the user to access console displays anywhere within a theatre or studio. A single wireless WiFi access point shall support multiple users and will support Wireless Handheld remote access simultaneously.

The system Web browser shall allow the operator to access and configure all SN110 nodes and other browser enabled network devices including hubs and wireless access points.

Furnish and install the following:

One (1) portable notebook computer with Windows XP operating system and USB memory key with system software installed. System shall include

- a. 30GB harddrive
- b. integral WiFi and wired Ethernet access
- c. 512MB ram
- d. 15 inch XGA display

One (1) wireless access point for remote system connectivity, Linksys #WAP-11 or equivalent with cat-5 cable for connection to Lighting Control Network.

One (1) Designers Remote Keyboard with dedicated keys to mimic console command and functions. Systems requiring "shortcuts" from a standard PC keyboard shall not be acceptable.

One (1) Strand Lighting Reporter Pro for Windows XP software (installed on PC outlined above) for configuration, monitoring, and patching of dimmer racks, network nodes, and architectural lighting controls.

#### 2.7 ARCHITECTURAL LIGHTING CONTROL SYSTEM

### General

System shall be microprocessor based, utilizing digital communications between the control stations, dimmers supporting the Digital Network protocol, or Digital Network Interface (DN Interface) cards.

System shall provide for the On-Line programming, editing, and recall of lighting presets via and or all of the following sources simultaneously:

- a. Lighting Control Console(s) and Remotes
- b. Network PC
- c. Architectural Control Stations

### Mechanical

The control station face plates shall be free of visible fasteners and shall be of aesthetic appearance.

Station face plates shall be fabricated of 0.025" (0.64mm) aluminum with an aluminum die cast trim frame.

Control stations shall be supplied in a off-white powder coat paint finish. Control station legends shall be printed in grey.

On control stations with sliders, the sliders shall have 1.75" (45mm) travel with grey slider knobs.

Control station push buttons shall have grey button caps with long life red LED linear array indicators.

### Installation

2 gang and larger control stations require flush mounted masonry ("ears-in") back boxes, with a minimum depth of 3.5" (90mm). Back boxes must be grounded/earthed in accordance with local wiring practices to provide a discharge path to ground for static electricity.

Single gang control stations require a standard 4" square J-box (i.e. Raco #231), a 4" square extension (i.e. Raco #203) of sufficient depth to increase the overall mounting depth to a minimum 3.5" (90mm), and a 1 gang reducer ring with an inside opening of at least 2.94"H (76mm) x 1.98"W (51mm)

Control stations shall be supplied complete with a sub-plate which is screwed to the flush mounting back box with the screws provided. The sub-plate allows the control station to be hinged into position and secured with hexagonal set screws on the bottom edge of the trim ring.

1/16" (1.6mm) Allen key shall be provided with each station.

It shall not be necessary to remove button caps or sliders, or to disassemble the control station for installation

Cable terminations shall be via a screw-terminal plug and socket to facilitate removing a control station while maintaining the continuity of the Digital Network.

### Operation

All stations require a 24 volt dc supply (nominally 100mA per station) from a remote power supply.

A 16 position rotary switch shall be provided on the back of each station for room selection.

Station switch positions 1-9, A-F and 0 (total 16) shall be valid. Each room shall have a maximum number of 12 channels of control.

All stations assigned to control a room will mimic the command actions from other stations within that room.

Dimmer cabinets shall contain factory default preset levels and a single fade time for each preset for all supported rooms. It shall be possible to reset the current stored preset levels of all rooms to the default from the dimmer cabinet.

All control functions shall be governed by, and all programmed and stored intensity levels (presets) shall be resident in the dimmer cabinets or DN Interface.

- d. A Belden 9773 cable shall provide a communication and low voltage power path from the dimmer cabinet(s) or DN Interface and power supply, to the control stations. The number of stations, dimmer cabinets and DN Interfaces that can be connected to the common communications cable shall be limited to 32. The total cable length shall not exceed 1000ft (300m).

#### Multi-Scene Recall Stations

8 Pushbuttons with corresponding LED indicators, labeled 1 through 8, for recalling presets stored in the dimmer electronics or DN interface. The presets shall have factory default levels but can be re-programmed and recorded from the Control Console or Network PC. Each preset shall have its own programmable fade time.

Re-selecting a currently active preset shall cause the channels within the room to fade to Off in a programmable fade time.

#### Single Scene Recall Stations

1 Pushbutton with corresponding LED indicator, for recalling presets stored in the dimmer electronics or DN interface. This Preset can be re-programmed and recorded from the Control Console or Network PC. Each preset shall have its own programmable fade time.

Re-selecting a currently active preset shall cause the channels within the room to fade to Off in a programmable fade time.

#### Cable Specification

Interconnection between the control stations and the dimmer cabinet(s) shall be:

- e. Cable: Belden 9773, 3 twisted pairs, each pair individually shielded.
- f. Conductors: 18 AWG.
- g. Nominal conductor resistance: 21.0  $\frac{\Omega}{\text{Km}}$
- h. Nominal shield resistance: 27.2  $\frac{\Omega}{\text{Km}}$
- i. Capacitance between conductors: 98 pF per meter
- j. Maximum cable run: 1000ft (300 m) in total
- k. #18 AWG color-coded cable. Number of conductors: 1, plus 1 per channel

#### Power Supply

Control stations require an external 24 volt dc power supply which can either be a self contained unit for mounting in a dimmer/distribution room, or, depending on the type of dimmer used, this supply may be derived from the dimming system.

1. Refer to Data Sheets on dimming products for further information.

#### Documentation

A Pocket Programming Guide shall be supplied with each system.

Project installation and connection drawings shall be supplied as specified.

#### Safety

Control Stations operate at 24 volt safe extra low voltage circuits (SELV) and contain no hazardous voltages.

#### Environmental Specification

For all Control Stations and associated equipment, including dimmers and power supply units, the following recommendations shall apply:

Ambient temperature extremes 32° - 104° F (0° - 40° C)

Relative humidity 10% - 90% non-condensing

General conditions Office level cleanliness - Interior use only.

Furnish and install the following:

(2) Strand Lighting #63021 Single Button Entry Stations with locking covers

(1) Strand Lighting #63028 8-Button Preset Recall Stations

### 2.8 ARCHITECTURAL AND PERFORMANCE DIMMER RACKS

#### General

The dimmer racks shall be fully digital, designed specifically for entertainment lighting, and shall consist of up to 48 dimmer module spaces. Dimmer rack systems shall be UL and cUL listed.

Rack setup and preset data shall, as standard, be fully user programmable on a per rack or system wide basis. The dimmer rack shall report rack and dimmer status to a remote personal computer or control console and, as an option, report load status information.

#### Mechanical

The dimmer rack shall be a free-standing, dead-front switchboard, substantially framed and enclosed with 16-gauge, formed steel panels. All rack components shall be properly treated, primed and finished in fine texture, scratch resistant, gray powder coat paint.

The dimmer rack shall not exceed 80"H x 24.5"W x 19.5"D. Racks shall be designed to allow for adjacent mounting and for bolting to the floor. The half dimmer rack version, consisting of up to 24 dimmer module spaces shall not exceed 57"H x 24.5"W x 19.5"D. Rack doors shall not increase the total rack depth by more than 1.0", and will not increase the rack footprint.

The rack shall be designed to allow for easy insertion and removal of all modules without the use of tools. Dimmer supports shall be provided

for precise alignment of dimmer modules into power and signal connector blocks.

Rack spaces shall be mechanically keyed such that modules of greater current capacity cannot be accepted for that space. Racks that allow modules of higher wattage to plug into the same space shall not be acceptable.

Multiple low-noise fans shall be provided to allow redundancy in case of fan failure. The fans shall maintain the temperature of all components at proper operating levels with dimmers at any load, providing the ambient temperature of the dimmer room does not exceed 40 degrees C and humidity of 10-90% non-condensing. Air shall flow over the surfaces of the heat generating components using a combination of convection and fan assisted air flow. Each rack shall be outfitted with a lockable door that does not impede air flow in any manner.

Fans shall be gradually controlled between off and full speed in order to minimize fan noise under all operating conditions. In the event of a rack over temperature condition, a warning shall be displayed on the rack or on a remote personal computer or control system. If the temperature rises 5 degrees C over the warning threshold, power to SSR control circuits will be automatically shut off.

Load terminations shall be clearly marked with the rack circuit number. Signal terminations shall be by plug-in screw terminals to facilitate contracting and servicing and shall be clearly labeled.

#### Electrical

Dimmer racks shall operate at 90 to 270VAC 3 phase, 4 wire + ground or 120 to 240VAC, 1 phase, 2 wire + ground, 47 - 63 Hz at a maximum of 800A per phase. Bussing across adjacent multiple racks shall be provided.

Load phase, neutral, and ground terminals shall, as standard accept up to a #6 gauge wire. An optional terminal adapter accepting up to #2 gauge wire shall be provided to minimize load voltage losses. Dimmer racks shall be braced for 50,000Amps. Provisions shall be made for optional amp trap devices to provide higher fault current protection, if required.

#### Environmental

The maximum ambient temperature shall be 40 degrees C.

Racks shall be installed in adequately ventilated environments with a minimum of dust.

The operating environment shall have a relative humidity of 10-90%, non-condensing.

#### Rack Electronics, Physical

The main dimmer control electronics shall be housed in one Rack Processor Module (RPM) plug in module. The dimmer control electronics shall be completely digital without employing any digital to analog demultiplexing schemes or analog ramping circuits.

All rack setup and preset data shall be stored in a non-volatile manner and may be transferred to a replacement Rack Processor Module without losing data.



Each Rack Processor Module shall have a back-lit LCD display with a six key keypad for rack setup, preset control, testing, rack status, error and diagnostics. Six LED's shall indicate mux inputs A and B OK, electronics power OK, processor OK (Built In Self Test), active processor, and dimmer module error.

All rack setup and preset data shall be electronically transferable between the main Rack Processor Module and the Backup Processor module in case of replacing either of the modules.

All rack setup and preset data shall be transferable to and from library storage on a personal computer on a per rack basis. The system shall be capable of monitoring multiple racks on a single cable connection.

A permanently mounted Central Interconnection Card (CIC) shall provide signal connections and security features in conjunction with optional rack mounted power supply units. The CIC shall provide the only point for contractor connection of signal cables and PANIC activation. The connections shall be made with two part plug-in screw terminals for ease of contracting.

All digital multiplex, RS-485 communication ports and remote contact input connections shall be optically isolated from all processor electronics by 2,500V RMS isolation.

The Central Interconnection Card shall have the provision to select any of a maximum of 96 dimmer and 12 analog outputs to be activated by a PANIC function. The PANIC function shall be activated or de-activated by one or more local or remote contact closures. The CIC shall provide a selection device to enable or disable the activation of PANIC when removing the RPM from an active rack. PANIC will not be automatically activated if a RPM is removed from an inactive rack. Racks that employ processor controlled PANIC functions shall not be acceptable.

The CIC module shall have LED's indicating:

- a. +5V for opto-isolation OK.
- b. Auxiliary power supply OK.
- c. PANIC active.
- d. Rack overheat warning.
- e. Power phases active.

#### Rack Electronics, Control and Communications

The control electronics shall provide the following control and communication inputs as standard:

- f. Two optically isolated DMX512 control inputs. The first input can be AMX192 as an alternative to DMX512. The second input is DMX512 only. Each mux input shall have a patch to allow overlapping or separation of any mux control level.
- g. 32 (96 channel processor) or 16 (48 channel processor) analog 0 to +10V signal inputs. The analog inputs shall be fully patchable to any rack dimmer circuit or analog output.
- h. Eight optically isolated contact inputs, for external

switching of functions.

- i. RS-485 optically isolated signal inputs for System Wide Control (SWC), and Outlook control system use. SWC is separate from the mux control signal, allowing sophisticated and independent remote control of circuits and presets through a hand held programmer and/or preset stations. Outlook is a control system comprised of architectural style panels for recording and playback of presets in individual assigned "rooms".
- j. One RS-232 signal input for local connection to a personal computer, providing setup, playback, library storage and reporter feature supervision.

The control electronics shall provide the following outputs as standard:

- k. Up to 96 phase controlled signals to control the dimmer SSRs.
- l. Twelve analog 0 to +10V signals for control of external devices, (with 96 channel processor).

#### Rack Electronics, Features

The dimmer control electronics shall have a dimmer update rate better than 16 ms (60 Hz) or 20 ms (50 Hz). Dimmer outputs shall exhibit no oscillating or hunting for levels. Dimmers set to the same level shall output within +/-1V of each other, regardless of phase or input voltage, providing the desired level is less than the phase input voltage less the dimmer insertion voltage, the load on the dimmers is the same and line is an undistorted sine wave.

The dimmer output levels shall be regulated for incoming line voltage variations provided. The input power supply must provide an undistorted sine wave at all times. The regulation shall adjust for both RMS voltage and frequency changes of the incoming AC wave form. Regulation shall maintain the desired output voltage +/- 2 volts for the entire operation range (100 - 240VAC) with the exception that the maximum output will be no greater than the phase input voltage less the dimmer insertion voltage. There shall be no interaction between dimmers in the system or any other equipment. The output shall be regulated to the user programmable maximum voltage level on a dimmer-by-dimmer basis between 50V and 240V.

The control electronics shall allow the maximum output levels of individual dimmers to be adjusted, e.g. to compensate for load circuit voltage loss. The selected dimmer curve shall regulate so that the curve is proportional to the programmed maximum voltage. Systems with status reporting dimmers shall have full line compensation with adjustment for changes in line and load, systems without this capability shall not be accepted.

The RPM shall also have the capability to support dimmers of different types and sizes that may be mixed throughout the rack. Individual dimmers may be dimmed or switched (non-dim). The individual phase control or switching of positive and negative line voltage half cycles shall not be acceptable, as the net resultant DC line current may damage or degrade line supply transformers.

The control electronics shall contain diagnostic routines to perform a self test (Built In Self Test). Standard status reporting shall consist of:

- m. Dimmer type in slot (user programmed data).
- n. Input line voltage per phase.
- o. Mux A input fail.
- p. Mux B input fail.
- q. Dimmer output level (%).
- r. Rack overheat warning.
- s. Rack overheat shut-down.

The control electronics shall provide the following setup functions that shall be user programmable on a per rack or system wide basis:

- t. Mux A patch.
- u. Mux B patch.
- v. Analog inputs patch.
- w. Architectural patch for Outlook control systems.
- x. Set rack circuit ID.
- y. Dimmer report enable/disable.
- z. Record preset and preset crossfade time.
- aa. Set SWC preset.
- bb. Set SWC backup preset.
- cc. Set architectural preset with Outlook control systems.
- dd. Set dimmer level (%).
- ee. Set dimmer max. voltage (24V - 250V in 1V steps).
- ff. Set dimmer min. level (0 to 99%).
- gg. Set dimmer curve.
- hh. Set dimmer response time.
- ii. Set control logic.

The mux A and B patching shall support a rack start address and individual dimmer patch. It shall be possible to patch the analog outputs to any mux A and B address. The architectural patch shall define the rack circuit / room / room channel relationship for Outlook control systems.

Each individual rack circuit shall have a 5-digit alphanumeric ID (Circuit ID) that is addressable by a personal computer connection or by SWC (SWC can access the first 4 digits), enabling continuous numbering over several mux spans or enabling other user programmable groupings or labeling.

The control electronics shall provide a facility to disable the output of any individual dimmer by setting the level to 0. It shall also be

possible to enable and disable dimmer status reporting on a per dimmer basis.

The control electronics shall contain 99 System Wide Control (SWC) user programmable presets and a permanent blackout preset (preset 0). It shall be possible to record individual preset crossfade times, including preset 0. The presets shall be simply user programmable as a snapshot of the current dimmer outputs resulting from all dimmer control sources according to selected control logic, on a per rack or system wide basis. Each preset may have an individual crossfade time between 0 seconds and 10 minutes.

The control electronics shall support a user assignable backup preset. Each rack shall, in the event of loss of mux control according to selected control logic, maintain the last levels for a user programmable period after which it shall automatically fade in the assigned backup preset. Alternatively it shall be possible to program the rack to indefinitely hold the last dimmer levels. Systems that do not offer this feature shall not be acceptable. It shall be possible to continue control without an active mux signal using any of the SWC or Outlook architectural presets as well as the analog inputs.

The control electronics shall provide an architectural Outlook control system preset capability of 8 presets plus full ON and OFF for each of 16 separate rooms with programmable fade times between 0 seconds and 4 minutes.

The control electronics shall provide the ability to set one or a group of dimmers to any level.

The control electronics shall provide the ability to set a library or user programmable curve to any individual dimmer. Library curves shall be:

- jj. Square curve.
- kk. S-curve.
- ll. Linear power output curve.

User selectable curves shall be:

- mm. Non-dim (switched) with a programmable trigger level 0 - 99%.
- nn. Electronic ballast fluorescent curve with a kick-start voltage and user programmable top set and bottom cut-off point.
- oo. Magnetic ballast fluorescent curve with user programmable top set and bottom cut-off point.
- pp. Five user defined programmable curves.

Each dimmer shall have one of three user programmable response in order to optimize lamp filament life and speed of operation:

- qq. Fast (30 ms).
- rr. Normal (100 ms).
- ss. Slow (300 ms).

The control electronics shall provide a number of user programmable control logic schemes, regulating the logical relationship between dimmer control sources:

- tt. Mux A highest takes precedence (HTP) with mux B, plus HTP with analog inputs, plus HTP with SWC presets, plus HTP with Outlook presets.
- uu. Mux A only HTP with analog inputs, plus HTP with SWC presets, plus HTP with Outlook presets.
- vv. Mux B only HTP with analog inputs, plus HTP with SWC presets, plus HTP with Outlook presets.
- ww. Mux A or mux B only HTP with analog inputs, plus HTP with SWC presets, plus HTP with Outlook presets (A or B mux selection via external contact closure).
- xx. Mux B over mux A HTP with analog inputs, plus HTP with SWC presets, plus HTP with Outlook presets.
- yy. Mux A over mux B.
- zz. SWC Presets HTP with Outlook presets, HTP with analog inputs over mux A HTP with mux B (on selection of a SWC preset other than 0).

#### Dimmer Peripheral Equipment

The dimmer system shall support the following range of specialist peripherals:

- aaa. Remote SWC backup preset panels.
- bbb. Remote SWC Stage Manager's auxiliary preset panels.
- ccc. Remote SWC hand held programmers.
- ddd. Remote personal computer for user programming, library storage of dimmer setup data and remote monitoring of dimmer and load status.
- eee. Remote Outlook panels for architectural style channel and preset control of separate and independent (rooms).

The dimmer system shall support a remote hand held SWC Programmer unit with 40 tactile keys and a 4 line by 16 character backlit LCD offering channel control using standard control system syntax and direct action level keys, preset and preset time recording and control and riggers functions Check+, Check- and Rem Dim. The SWC programmer shall be functional with distributed dimming systems in conjunction with other SWC panels and shall not require the presence of a control system to function. Dimming systems that do not offer this facility shall not be acceptable.

The dimmer system shall support 8- and 16-preset SWC wall mounted panels with tactile keys and integral LED indicators per key. The panel shall control 8 or 16 consecutive presets stored in the dimmer racks following a user programmable start address. The panel shall enable the recording of presets, the playback of presets and the turning off of the active playback. It shall be possible to disable the panel recording function. It shall be possible to connect a total of 30 SWC programmers or panels on one SWC system.

The dimmer system shall support a range of wall mounted Outlook architectural style panels consisting of preset keys with integral LED's, channel and master faders for setting, recording and playback of architectural style presets in individual assigned zones (rooms). Additional peripherals shall consist of panels allowing the zone (room) channels and presets to be joined and un-joined, infra-red remote control for up to 8 zone (room) presets and Audio-Visual (A/V) interface units enabling 8 dimmer presets, on and off to be controlled by external contact closures

Provide the following:

Qty (8) Strand Lighting #74311/ CD80SV Dimmer Bay fully wired for 48 Modules

Qty (6) Strand Lighting #74384/ CD80SV 96 Dimmer Processor w/single electronics

Qty (2) Strand Lighting #74384-65110-XX/ CD80SV 96 Dimmer Processor w/single electronics and installed ShowNet Network Node

Qty (8) Strand Lighting Spare Hardware Kit for CD80SV Dimmer Rack

Qty (4) Strand Lighting Cross-Bussing Kit for CD80SV Dimmer Rack

## 2.9 ARCHITECTURAL AND PERFORMANCE DIMMER MODULES

### General

The dimmer modules shall be designed using advanced, state-of-the-art components specifically for entertainment lighting.

### Physical

The dimmer modules shall be fully plug in and factory wired. Dimmer modules shall be of rugged and heavy-duty construction enclosed by a formed aluminum chassis. Power and signal pins shall be recessed in a self-aligning housing to avoid handling, storage, and insertion damage. A contoured handle shall be provided for ease of insertion and withdrawal. All chassis parts, except heat sinks and handle, shall be properly treated, primed and finished in fine texture, scratch resistant, gray powder coat paint. Each module shall be labeled with the manufacturer's name, catalog number and rating. Modules constructed of molded plastic for structural support shall not be acceptable. Dimmer modules shall be UL and cUL recognized devices.

Dimmer modules shall be keyed so that dimmer modules of greater capacity shall not be interchangeable.

Standard factory modules shall be available to provide dedicated non-dim circuits not employing SSR devices. Dual modules shall be available providing non-dim/dimmer, dimmer/non-dim and non-dim/non-dim configurations. Each non-dim shall be provided with a primary circuit breaker of the appropriate rating. Non-dims shall be designed so they can be used for inductive loads.

Standard factory modules shall be available to provide hard fired output for use with neon, cold cathode, and fluorescent loads. Hard Fired modules shall provide a current source independent of the load current for the SCR Gate Drive Signal. Hard fired dimmers shall function independent of load as a result and shall drive loads of 1 watt or less. Systems without this capability shall not be accepted.

### Electrical

Each dimmer module shall contain one or two single pole circuit breakers, associated solid state switching modules, filters, power and control components.

Dimmer electronics shall be completely solid state. They shall utilize two silicon-controlled rectifiers in a back-to-back electrical configuration. The full load of the circuit is to be carried and controlled by the silicon controlled rectifiers.

Each dimmer shall be protected by a fully magnetic circuit breaker of the appropriate current rating and 10,000 AIC surge rating mounted on the face plate of the dimmer module so that the trip current is not affected by ambient or rack temperature. The circuit breaker shall be rated for tungsten loads having an inrush rating of no less than 20 times normal current and shall disconnect the power to the dimmer module before damage can be done to the dimmer power components. The circuit breakers shall be rated for 100 percent switching duty applications and shall be a UL and cUL recognized device.

#### Solid State Relay (SSR)

SSR devices shall be encapsulated, epoxy filled high impact plastic cases with optically isolated firing circuits, control circuitry, and two silicon controlled rectifiers (SCRs). There shall be a minimum of 2,500 volts RMS of isolation between the AC line and the control lines of the SSR.

The SCR shall be in an industry standard format that is easily field replaceable without removing any other electrical or electronic devices.

#### Filtering

Each dimmer module shall have an integral inductive filter to reduce the rate of current rise time resulting from the SCR switching on. The filter shall limit objectionable harmonics, reduce lamp filament sing and limit the radio frequency interference on line and load conductors.

Type (i) dimmers shall have a rise time of not less than 350 microseconds measured at 90 degrees conduction angle from 10% to 90% of output wave form with dimmer operating at maximum load. Voltage rate of rise (slew rate) must not exceed 420 millivolts per microsecond in any point of the wave under full load conditions.

Type (ii) dimmers shall have a rise time of not less than 500 microseconds measured at 90 degrees conduction angle from 10% to 90% of output wave form with dimmer operating at maximum load. Voltage rate of rise (slew rate) must not exceed 300 millivolts per microsecond in any point of the wave under full load conditions.

Type (iii) dimmers shall have a rise time of not less than 800 microseconds measured at 90 degrees conduction angle from 10% to 90% of output wave form with dimmer operating at maximum load. Voltage rate of rise (slew rate) must not exceed 210 millivolts per microsecond in any point of the wave under full load conditions.

The use of type i, ii, or iii dimmers shall not reduce rack density. 2.4kW and 6.0kW modules are available as types i, ii, or iii. 12.0kW modules are available as type i.

#### Performance

The dimmer module shall be capable of "hot patching" cold, incandescent loads up to its full rated capacity without malfunction with the control signal at full ON.

The dimmer power efficiency shall be at least 97% at full load with a no load loss of 3V RMS for type i dimmers.

Provide the following:

Qty (384) Strand #72316/CD80SV Dual 2.4kw FF Dimmer Module, type (iii) for Performance and Architectural Lighting.

Qty (6) Strand #72382/CD80SV Dual 2.4kw FF Dim/ Non Dim Module

Qty (6) Strand #72384/CD80SV Dual 2.4kw FF Non-Dim/ Dim Module

Qty (12) Strand #72316/CD80SV Dual 2.4kw FF Dimmer Module, type (iii) (spare)

#### 2.10 EMERGENCY LIGHTING TRANSFER (BATS) CABINET:

The Emergency Lighting Transfer Cabinet shall provide automatic transfer of branch circuits from normal to emergency power when normal power fails. The cabinet shall automatically reconnect circuits to normal power when normal power has been restored. The Emergency Lighting Transfer Cabinet Switches shall be electrically operated and mechanically held. The entire assembly shall be UL1008 listed and labeled. This equipment must comply with the regulations in NFPA 110 for Emergency and Standby Power Systems.

The Emergency Lighting Transfer Cabinet must satisfy the requirements of the following NFPA 70 (National Electric Code).

- Article 701 - Legally Required Standby Systems

- Article 700 - Emergency Systems

- Article 540-11c - Motion Picture Houses

- Article 520-7 - Theatres and Similar Locations

- Article 518-3c - Places of Public Assembly

The Emergency Lighting Transfer Cabinet shall be a wall-mounted, NEMA 1 enclosure constructed of 14 gauge steel finished in gray powder coat paint. All terminations and wiring shall be accessible via a hinged lockable door. The cabinet shall be pre-wired and tested at the factory with clearly marked terminals for contractor wiring of normal feed, emergency feed, lighting loads and sensing feeds.

Emergency Lighting Transfer Cabinets shall be provided with a Three Phase - 120/208V rating. Standard transfer relays shall be available at 20A and 50A current ratings.

The Emergency Lighting Transfer Cabinet shall provide for power distribution and branch circuit protection internally for all emergency power circuits. Systems requiring external emergency power circuit protection shall not be acceptable.

The front panel of the Emergency Lighting Transfer Cabinet shall contain a keyswitch to simulate power failure for testing purposes as well as indicator lights to visually signal the presence of normal or emergency power.

Voltage sensing of the Normal source shall cause automatic transfer when the voltage of one or more phases drops below 55%.

Factory default settings for time delay of transfer are as follows:  
Normal to Emergency - 0 Seconds, Emergency back to Normal 3 Seconds.



These settings are field adjustable.

Provisions for optional remote signal, fire alarm and other input signals shall be incorporated into the control circuit.

Provide Emergency Lighting Transfer Cabinets (BATS Panels) as indicated on the project drawings.

#### 2.11 CIRCUIT DISTRIBUTION:

##### Connector Strips

Each section shall consist of a 4" x 4" (102mm x 102mm) 18 gauge steel or Aluminum wireway with removable cover sections for access, labeled with 2" high die-cut white circuit numbers on both sides of the connector strip.

Each strip shall have a terminal compartment which shall be factory installed on the right or left end as required and shall contain molded barrier type terminals for feed connection.

The strip shall be provided with heavy steel mounting straps on approximately 5' (1.52m) centers, to grip up to 2" (51mm) pipe.

Type S or SO, 18" (457mm) cable pigtails shall be secured by strain reliefs and shall be furnished with three pole grounded female receptacles. Flush receptacles are available in lieu of pigtails. Internal wiring shall be rated at 125 C.

External finish shall be powder coat epoxy in a color to be determined by the Architect from samples provided by the Contractor.

The entire unit shall be UL and CSA approved and labeled. Unit shall be manufactured by Union labor and be so labeled.

##### Gridiron Boxes

Each unit shall be a surface mounted code gauge steel box located as shown on the drawings.

The unit shall be provided with terminal strips for feed connections. Knockouts, cables clamps and "Kellums" cable grips shall be provided, when appropriate.

Access shall be by means of a removable cover.

Weights and dimensions shall be:

- a. 8 & 15 Circuit: 9lbs. (4kg), 18" x 10" x 4" (460 x 255 x 100mm)
- b. 20 Circuits: 12lbs. (4kg), 18" x 15" x 4" (460 x 380 x 100mm)
- c. 30 & 36 Circuits: 14lbs. (6.3kg), 24" x 15" x 4" (610 x 380 x 100mm)
- d. 50 Circuits: 20lbs. (9kg), 24" x 18" x 4" (610 x 460 x 100mm)

External finish shall be powder coat epoxy in a color to be determined by the Architect from samples provided by the Contractor.

##### Plug-In Boxes with Pigtails

This unit shall be a recessed, surface or pipe mounted box as shown on the drawings.

The back box shall be 18 gauge steel with two sets of knockouts on each side.

Female receptacles shall be three pole grounded type attached to 18" (457mm) rubber covered cable pigtails.

External finish shall be powder coat epoxy in a color to be determined by the Architect from samples provided by the Contractor.

The unit shall be UL listed and CSA approved in Canada.

The surface mounted unit shall weigh 11lbs. (5kg). The recessed unit shall weigh 9lbs. (4kg).

The dimensions of the unit shall be 12" x 6" x 5" (305 x 150 x 127mm)

Provide Connector Strips, Gridiron Junction Boxes, SO Cables, Kellums Grips, Cable Cradles, and Plug-In boxes with appropriate mounting hardware in the quantities and configurations shown on the Project Drawings.

## 2.12 PERFORMANCE LIGHTING FIXTURES

GENERAL DESCRIPTION Provide all lighting fixtures with a half coupler, 20 AMP 2P&G connector with strain relief as necessary (Union connector model 2P&GM or equal) installed, safety cable (Altman model SC or equal), appropriate sized color frame for each lamp window, lamp as noted or highest rated wattage lamp allowed by specification.

All stage lighting fixtures are to be unpacked and the lamp(s) installed at the jobsite.

All stage lighting fixtures are to be bench focused with installed lamp at the jobsite. Fixtures that are adjusted at the manufacturers factory will not be accepted.

All stage lighting fixtures are to be installed at specific locations as per the system drawings and the owners instructions.

Standard Theatrical Pipe clamps shall not be acceptable as they can damage the finish of the trussing system.

## IRIS CYCLORAMA LUMINAIRES

### General

- a. The Iris cyclorama luminaires shall be of modular construction to allow for four basic versions: one, two, three and four light units. Each compartment shall accommodate 1000W or 1500W double-ended tungsten-halogen lamps.

### Mechanical

- b. The sockets shall be mounted within a multi-curve, anodized, high purity aluminum reflector designed for maximum efficiency and smoothness of field.
- c. The housings shall be of sheet steel with a specially designed serrated diffuser edge at the base of each compartment.
- d. Both the reflector and the housing shall be vented to allow the use of high-temperature plastic color media. A 3mm wire mesh safety screen shall be provided with all luminaires of this type.

- e. Exterior finish shall be black baked enamel
- f. The weight shall be:
  - 1) Iris 1: 15lbs (8.5kg)
  - 2) Iris 2: 27lbs (15.5kg)
  - 3) Iris 3: 39lbs (22.5kg)
  - 4) Iris 4: 53lbs (28.5kg)
- g. The luminaire shall have the following dimensions:
  - 1) Iris 1: 9.75" (247mm) D x 20.4" (517mm) W x 15.8" (402mm) H
  - 2) Iris 2: 9.75" (247mm) D x 36.29" (922mm) W x 15.8" (402mm) H
  - 3) Iris 3: 9.75" (247mm) D x 52.7" (1327mm) W x 15.8" (402mm) H
  - 4) Iris 4: 9.75" (247mm) D x 36.29" (922mm) W x 28.8" (757mm) H
- h. The color frame size shall be : 16" x 12 1 /4" (405 x 310mm).

#### Electrical

- i. The supply voltage shall be 120V, 60Hz. 220V versions shall be available.
- j. The maximum lamp wattage shall be 1500W.
- k. A 3 feet 3 x 14 AWG power cable shall be supplied.
- l. The unit shall utilize double ended tungsten halogen lamps (R7 base).
- m. The entire unit shall be UL listed and CSA approved.

#### Optical System

- n. The sockets shall be mounted within a multi-curve, anodized, high purity aluminum reflector designed for maximum efficiency and smoothness of field.
- o. Lamp access shall be through the front of the open face of the unit, after the color frame and wire guard are removed.

#### Environmental

- p. The maximum ambient operating temperature shall be 115°F.
- q. The angles of use shall be from vertical to -45°. The cyclorama lights shall be designed to evenly illuminate cycloramas up to 23' high with maximum illumination at performer head height of 6'. The units shall rely on the overlap of light from adjacent units which should be installed on 8' centers and tilted down 20° from vertical.

#### Performance

r. The lux levels shall be, for an FFT 1000W 120V lamp:

Cyclorama Height (ft)	18	15	12
Distance from Cyc (ft)	8	6.5	5.0
Spacing on centers (ft)	8	6.5	5.0
Lux level at 6ft high	100	120	140

s. The unit shall produce a smooth uniform field with less than +5% deviation from top to bottom on a 24' (7.3m) cyclorama using units on 8' (2.4m) centers.

t. Horizontal deviation shall not exceed +3%.

#### Included Furnishings

- u. One color frame for each compartment
- v. One wire guard for each compartment
- w. Iron C-clamp to grip up to 2" (51mm) pipe
- x. Steel yoke
- y. 39"' (1m) leads in fiberglass sleeving, or with connectors as specified

#### Provide the Following:

- z. (20) Strand Lighting #26077 Iris 1 Cyclight, 1000w

#### SL SERIES ELLIPSOIDAL SPOTLIGHT - 5° to 50°

#### General

- aa. The SL Series shall be an ellipsoidal reflector 575W spotlight, available in 5°, 10°, 19°, 26°, 36° and 50° beam angles.
- bb. The luminaire shall have a precision optical system designed around a Dichroic reflector in combination with a high efficiency lamp and shall feature a teflon-smooth lens adjustment.
  - 1) The Dichroic glass reflector shall provide both high light output and cool beam operation for extended pattern and color life.
  - 2) The luminaire shall have a lamp centering/field adjustment mechanism and a bayonet action lamp changing system which simplifies lamp changes by maintaining field adjustments.
  - 3) Peak/Flat field adjustment shall be via screw drive mechanism to insure smooth, tool free field settings.
- cc. The luminaire shall be UL and cUL listed.

#### Mechanical

- dd. Adequate ventilation shall be provided in the form of openings in the body with proper baffling to prevent light leaks. Further reduction of the temperature shall be accomplished through the use of a heat sink around the lamp receptacle.

- ee. The lamp, reflector, shutters and template slot, shall be mounted within a die-cast aluminum housing.
- ff. The lenses for the 19 - 50 shall be mounted in interchangeable die cast lens tubes and the 5 and 10 mounted in interchangeable metal spun tubes , designed to provide for sharp or soft definition of the beam without allowing the passage of stray light rays or extraneous internal reflections from the lens tube.
- gg. The lens tubes between 5 to 50 degree luminaires shall be interchangeable.
- hh. This tube shall be fitted with heavy duty color frame holders capable of holding two standard metal color frames.
- ii. The Housing shall rotate 360 degrees to provide optimum luminaire orientation at all times. Luminaires offering limited range of motion shall not be accepted.
- jj. The shutters shall be stainless steel. The shutters shall operate in three independent planes. It shall be possible to align any two adjacent shutters parallel to one another. The three plane gate assembly shall make triangular patterns possible. Shutters shall be held in a spring loaded gate assembly.
- kk. Pattern and gobo size shall be B.
- ll. Exterior finish shall be black epoxy powder coat.
- mm. Overall length of the unit shall not exceed
- nn. 5° 41" (1035mm) plus 3" (70mm) for lens focus.
- oo. 10° 26" (665mm) plus 3" (70mm) for lens focus.
- pp. 19 - 50° 20" (507mm) plus 3" (70mm) for lens focus.
- qq. Weight shall not exceed
- rr. 5° 17.6lbs (8.0kgs)
- ss. 10° 15lbs (6.8kgs)
- tt. 19 - 50° 15lbs (6.8kgs)

Furnish and install the following:

- uu. (24) Strand Lighting #11421 23/50deg SL Series Zoom Spotlight, 575w
- vv. (80) Strand Lighting #11341 36deg SL Series Spotlight, 575w
- ww. (24) Strand Lighting #11331 26deg SL Series Spotlight, 575w
- xx. (24) Strand Lighting #18045 Gobo Holder, Size B
- yy. (24) Strand Lighting #18115 Top Hat for SL 19 - 50

6 " FRESNELITE SPOTLIGHT - Theatrical

General

- zz. The luminaire shall be a variable focus fresnel spotlight designed to accommodate tungsten-halogen or incandescent medium pre-focus base lamps in 500, 750, and 1000 watt sizes.

Mechanical

- aaa. The housing shall be constructed of ribbed extruded aluminum sides between die-formed steel cover plates.
- bbb. Lens door construction shall be of spun steel for strength and durability. Die cast aluminum accessory clips shall be screw retained to the lens door and shall be capable of holding a combination of a barndoor and three color frames and/or scrims.
- ccc. Lamp and reflector access shall be through the side-hinged lens door. The door shall be secured with a spring-loaded stainless steel latch with a thermally insulated sweep arm.
- ddd. Focus position shall be indicated by a calibrated label.
- eee. Exterior finish shall be black baked enamel.
- fff. The weight shall be 10.5 lbs. (4.8kg).

Electrical

- ggg. The unit shall be available with a medium pre-focus lamp base.
- hhh. The entire unit shall be UL listed and CSA approved.

Performance

- iii. The unit shall have a 6 to 55 degree variable 1/2-peak angle and a 13 to 65 degree 1/10 -peak angle.
- jjj. The unit shall produce 194 foot-candles at 30' (2160 lux at 9m) maximum (spot focus) and 46 footcandles at 20' (514 lux at 6m) maximum (flood focus) using a BTR lamp.

Included Furnishings

- kkk. Iron C-clamp to grip up to 2" (51mm) pipe
- lll. Steel yoke
- mmm. 3' (0.9m) leads in fiberglass sleeving, or with connectors as specified
- nnn. Each Luminaire shall be UL and CSA listed and approved. Units which fail to meet this requirement shall not be acceptable.

Furnish and install the following:

- ooo. (40) Strand Lighting #12087 Fresnelite, 1000W
- ppp. (40) Strand Lighting #18127 Accessory Safety clip, 6" Fresnelite
- qqq. (40) Strand Lighting #18118 Barndoor, 6" Fresnelite

FOLLOWSPOT:

The luminaire shall be a 1200 watt follow spotlight designed to be used with a 1200HB Metal arc lamp. Xenon lamps shall not be acceptable.

The M2 spotlight system is a collection of modules that, depending on configuration, when assembled will yield follow spotlights capable of wide angle short throw to narrow beam long throw units.

rrr. The modules consist of main chassis, gate, 1200 watt lamp house, short, medium, and long throw lenses, Yoke and base assemblies, and magnetic and flicker free electronic power supplies.

sss. Modules are easily reconfigured in the field to change operating characteristics.

The optical train shall consists of a spherical reflector, lamp, precision high temperature condenser lens, heavy duty nichrome iris with heat shield, square chopping shutter, gobo holder, externally operable "flip flop" lens, 4 Color dichroic changer, variable frost filter, fader, six color automatic self-canceling color changer, and front objective lens.

The Flip flop lens allows the spotlight to change from a fixed focus lens system to a variable focus lens system; Spotlights without this change over ability shall not be acceptable.

A safety switch shall be fitted to the top, and a heat sensor located within the lamp house shall be included. Lamp houses without access and temperature limit safeguards shall not be acceptable.

Power to the spotlight shall be controlled via two push buttons mounted on the spotlight head for units equipped with a magnetic ballast.

For units equipped with a magnetic ballast, the fixture shall be fitted with a quick release multi-pin connector for connection to the remote magnetic ballast.

The #927 remote magnetic ballast shall operate the 1200 watt lamp and will operate on 120 volts 60 Hz at 20 amps maximum.

The yoke shall allow for a maximum tilt of 55 degrees below the horizontal and 35 degrees above horizontal. A stable 3 legged folding base with locking casters and leveling jacks (4 Legs for the long lens configuration) shall be provided.

The spotlight shall be fan cooled.

Provision shall be made that when modules are changed the tilt balance is maintained.

The spotlight body shall be constructed of cold rolled sheet steel and aluminum extrusions and be finished in light grey and black powder coated wrinkle finish.

The Followspot shall provide a 12' Diameter Beam with a flat an even illumination of 123fc at a throw distance of 180' with the unit spotted down and the iris open.

The spotlight shall contribute minimal acoustical interference to audience members and performers in the facility.

ttt. Followspot noise shall not exceed measured levels for the specified product at the operators position as detailed by Appendix 1 to this specification section.

uuu. Contractors proposing alternate equipment shall, at the sole expense of the contractor, perform tests on proposed equipment in the facility and provide results to the Architect prior to approval.

vvv. Testing for proposed substitutions shall be performed by an acoustical firm approved by the Architect.

The spotlight shall be the Lycian Stage lighting M2 Modular spotlight system.

Furnish and install (4) Lycian #2040-12 M2 Followspots with 1200W lamp, Magnetic Ballast, Stand, and Medium Throw Lens.

EXTENSION CABLES:

Stage pin extension cable shall be constructed of 12/3 type SO cable and shall have (1) male in-line stage pin connector and (1) female in-line stage pin connector permanently installed within the methods and parameters of the connector manufacturer. All connectors shall be installed with appropriate strain relief

Furnish and install the following:

www. (24) 5' Extension Cables

xxx. (24) 10' Extension Cables

yyy. (12) Female 5-15R to M2P&G Adapters (12" long)

Spare Lamps:

Provide spare lamps of each type. The quantity provided shall be ten percent of the quantity of each lamp type used in fixtures, rounding up in the case of partial units (i.e. (4) spare lamps per (34) lamps used in fixtures, etc.).

Fixture Installation and Focus

Stage Equipment Contractor shall develop, document, and install a "Rep" Lighting plot utilizing the equipment provided under this section as a part of this contract.

Lighting plot shall be developed upon consultation with the owner regarding the use of the facility and the required lighting.

Documentation of the Lighting Plot shall include, at a minimum, the following information documented as per the standards of the Theatrical Lighting Industry:

zzz. Plan Drawing showing the location, circuiting, and focus of all performance lighting fixtures

aaaa. Fixture schedules by hanging position detailing fixture type, lamp, color, focus, circuit, and control channel.

bbbb. Dimmer Hook-up detailing fixture type, hanging location, lamp, color, focus, and control channel.

cccc. Channel Hook-Up detailing fixture type, hanging location, lamp, color, focus, and dimmer.

dddd. Focus charts detailing the focus of all fixtures indexed per hanging position in relation to fixed points in the facility.



Contractor shall submit the Lighting Plot for approval prior to installation.

Contractor shall update the Lighting Plot following installation and include in the Manuals for the system.

## 2.13 PERFORMANCE TRUSSING SYSTEMS

### General

The Performance Trussing Systems shall be attached to the Building Structure and shall provide support and mounting positions for the Performance Lighting Fixtures, Circuit Distribution, Network Nodes, and Network Receptacles.

The Performance Trussing Systems shall provide support for the Acoustical Reflectors.

The Performance Trussing System shall be Manufactured by a single Company engaged in the design and manufacture of aluminum trussing systems for performance lighting applications of similar size and scope for a period of not less than ten (10) years.

The Manufacturer of the trussing system shall provide engineered drawings of the system and its components stamped by a professional engineer for approval prior to the fabrication and installation of the trussing system.

### Construction

Trussing Sections shall be constructed of 6082 T6 Aluminum Tubing of various diameters and lengths

Trussing shall be fabricated by certified welders in accordance with American National Standard ANSI/AWS D1.2-97

Trussing System components shall be, at a minimum, rated to support the following loads:

- a. 2000 lbs uniformly distributed load between supports spaced not less than 30' center to center.
- b. 1000 lbs center point load between supports spaced not less than 30' center to center.

### Mechanical

#### Structural Tubes

- c. The Main Chords shall be constructed of 2 inch outside diameter tubes with a minimum wall thickness of 0.125" (1/8").
  - 1) Main chords are cut to the overall length of each trussing section.
  - 2) Each section contains 4 main chords.
- d. Horizontal Chord bracing shall be constructed of the same material as the main chords and shall be 8 13/16" in length, cut to form to the main chords
- e. Diagonal Bracing shall be constructed of 1" outside diameter tubes with a wall thickness of 0.125" (1/8").

#### End Bracing Box

- f. End Bracing shall be constructed of 2 inch x 1 inch box with a wall thickness of 0.125" (1/8"). Corners of the box shall have a 3mm radius.
- g. Box shall be cut to a length of 8 7/8" with the ends mitered to 60.0 degrees to fit against the main chords.
- h. Box shall be inset from the end of the main chords 10mm (0.394") to allow for end plates

#### End Plates

- i. End Plates shall be 11" long x 3-1/8" wide x 10mm (.0394") thick.
- j. End Plates shall have an additional flange on the inside (away from the joint) that extends another 0.59", providing an overall thickness of 1".
- k. End Plates shall be mitered on flat at 45.0 degrees.
- l. End Plates shall be drilled with (2) 11/16" holes for the purpose of bolting trussing section together. Holes shall be spaced 6-11/16" on center, 1-1/8" inset from the flange side.

External finish shall be powder coat epoxy in a color to be determined by the Architect from samples provided by the Contractor.

Trussing System shall be similar in design and function to the GP 12x12 12" Box Trussing System as manufactured by James Thomas Engineering.

Provide Lifting points as required supporting trussing sections running East/West approximately 20'-0" on center.

Furnish and install Trussing Sections, Corner Blocks, Lifting Points, and Hardware as required to provide for trussing systems as shown on the project drawings.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

The Stage Equipment Contractor shall be responsible for storage of stage equipment and tools during the period of installation.

Extent: All specified equipment shall be installed by fully trained superintendents and workmen. Equipment shall be installed in a workman-like manner per plans and specifications. Equipment shall be aligned, adjusted and trimmed for the most efficient operation, the greatest safety and the best visual appearance.

Standards: Installation practices shall be in accordance with OSHA Safety and Health Standards and all local codes. All welding must be performed in full compliance with the latest edition of the Structural Welding Code (ANSI/AWS D1.1)

Alignment: Mule blocks, cable rollers and guides shall be installed, as required, to provide proper alignment, to maintain specified fleet angles, and to prevent contact with other surfaces.

Attachments: All equipment shall be securely attached to the building structure. Underhung blocks and mule blocks shall be welded in place unless otherwise directed.

Finishes:

All welds must be touched up to match disturbed finishes.

All finishes which are disturbed during shipping and installation shall be touched up to match original.

### 3.2 CLEAN UP

The Contractor shall be responsible for clean up, including removal of packing materials, etc., and the protection of surfaces or equipment provided by other contractors.

### 3.3 INSPECTION AND TESTING

Inspection: During the installation of equipment, the Stage Equipment Contractor shall arrange for access as necessary for inspection of equipment by the Owner's representatives.

Contractor shall test and verify each and every load circuit connected to the dimming system prior to system commissioning.

Contractor shall test Performance load circuits with a 2000w load and verify correct operation of the dimmer from 0 to 100% on a 10 second fade.

Contractor shall generate and provide a written report detailing that all circuits have been tested and are operating correctly.

Contractor shall notify the Electrical Contractor immediately of any miswired circuits.

Contractor shall test each and every DMX Port on Lighting Control Network Nodes prior to System Commissioning and shall generate and provide a written test report certifying correct operation.

Special Testing: If specifications, the Architect's instructions, laws, ordinances or any public authority require any work to be specially tested or approved, the Stage Equipment Contractor shall give the Architect timely notice of its readiness for inspection and of dates of inspections made by other authorities.

Completion Testing: Upon completing the installation of all equipment specified under this section, the Contractor shall notify the Architect, who will schedule an inspection.

At the time of inspection, the Stage Equipment Contractor shall furnish sufficient workers to operate all equipment and to perform such adjustments and tests as may be required by the Owner's representative.

Any equipment which fails to meet with approval shall be repaired or replaced with suitable equipment and the inspection shall be rescheduled under the same conditions as previously specified.

At the time of these inspections, no other work shall be performed in the auditorium and stage areas. All temporary bracing, scaffolding, etc. shall be removed to permit full operation of and access to all equipment.

Final approval will be withheld until all systems have been thoroughly tested and found to be in first class operating condition in every particular.

### 3.4 DEMONSTRATION

Demonstrate the system to prove compliance with requirements. Arrange and Pay for the services of a factory-authorized service representative

to demonstrate Performance Lighting and Rigging Systems prior to turn-over of the facility to the owner.

Contractor shall demonstrate the operation of each and every DMX connection port in the Lighting Control Network

Contractor shall demonstrate correct operation of the Lighting Control Console.

Contractor shall demonstrate correct operation of the Network PC, including:

- a. Network Configuration
- b. Dimmer Rack Configuration and Monitoring
- c. Configuration, monitoring, and programming of the Architectural Lighting Control System.

Contractor shall demonstrate operation of the Followspots and Performance Lighting Fixtures.

Contractor shall provide written certification of the Ethernet wiring for the Lighting Control Network.

Contractor shall demonstrate the "Rep" Plot of Performance Lighting fixtures as installed with appropriate documentation.

Provide written certification of the correct operation of each and every dimmer and circuit connected to the Performance and Architectural Dimming System.

Demonstrate correct operation of the Architectural Lighting Controls and adjust preset levels as requested.

Demonstrate the system to prove compliance with requirements. Arrange and Pay for the services of a factory-authorized service representative conduct a minimum of forty (40) hours of training, including systems operation and maintenance procedures, as follows:

(1) 8-hour session upon system commissioning detailing the following:

- d. Lighting Control Network Concepts, operation, and programming
- e. Basic Operation of the Lighting Control Console.
- f. Basic Operation and Maintenance of the Dimmer Racks.
- g. Basic Operation of the Network PC
- h. Operation and Maintenance of Architectural Lighting Controls

(1) 8-Hour session prior to turn-over of the system to the Owner, detailing the following:

- i. Implementation, maintenance, and adjustment of the "Rep" Plot.
- j. Followspot Operation and Maintenance
- k. Advanced Operation of the Lighting Control Console and Peripherals

(1) 8-Hour session 30 days following turn-over of the system to the owner, detailing the following:

- l. Review of Rep Plot implementation, maintenance, and adjustment
- m. Review of Lighting Control Network concepts, operation, and programming
- n. Review of Network PC operation
- o. Review of Lighting Control Console Operation

(1) 8-Hour Session (90) days following the turn-over of the system to the owner for the purpose of review and basic instruction of additional personnel.

(1) 8-Hour Session (180) days following the turn-over of the system to the owner for the purpose of review and basic instruction of additional personnel.

Schedule training with at least (14) days advance notice.

Video Training: Provide an S-VHS format submaster and two VHS copies of an instructional Videotape covering features, capabilities, operation, and maintenance of installed Performance Lighting Systems. Illustrate actual equipment and related functions. Show cause-and-effect sequence during operation. Cross Reference instruction manuals throughout. Follow same order and presentation as instruction manual.

Contractor shall provide the services of a factory authorized technician for the Dimming and Control Systems for not less than (2) 8-Hour days to assist the owner in preparation for the first event in the facility following completion of the project. This service shall be provided in addition to the training requirements outlined above.

-- End Of Section --

SECTION 11106

EXHIBIT CASEWORK  
07/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |             |   |
|-------------|---|
| ANSI A208.2 | (1994) Standard for Medium Density Fiberboard (MDF)       |
| ANSI Z97.1  | (1984; R 1994) Safety Glazing Materials Used in Buildings |

ASTM INTERNATIONAL (ASTM)

- |             |  |
|-------------|--|
| ASTM B 221  | (2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes          |
| ASTM B 221M | (2002) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) |
| ASTM C 1048 | (1997b) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass               |
| ASTM C 1172 | (1996e1) Laminated Architectural Flat Glass  |
| ASTM E 84   | (2003) Surface Burning Characteristics of Building Materials                               |
| ASTM F 152  | (1995; R 2002) Tension Testing of Nonmetallic Gasket Materials                             |

1.2 GENERAL REQUIREMENTS

Work in this section includes museum-grade exhibit casework.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office

that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings; G, AE

Shop drawings showing all fabricated casework items in plan view, elevations and cross-sections to accurately indicate materials use, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawings shall include a color schedule of all items.

SD-03 Product Data

Exhibit Casework; G, AE

Manufacturer's descriptive data and catalog cuts.  
Manufacturer's installation instructions, and cleaning and maintenance instructions.

SD-04 Samples

Aluminum top and bottom door rail; G, AE

Section of extruded aluminum door rail with polyurethane finish. Sample shall be 6" long.

07 Certificates

Exhibit Casework; ,

Certificate of compliance signed by Contractor attesting that completed casework and individual components conform to the requirements specified.

Material Safety Data Sheets (MSDS)

Material Safety Data Sheets for all components used in construction of exhibit cases.

1.4 QUALITY CONTROL

Manufacturer: Company specializing in manufacturing products specified in this section.

Installer: Company specializing in performing work in this section with a minimum of three years documented experience approved by the manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered to the building site in the manufacturer's original unopened packing and shall be stored in a clean dry area with temperature maintained above 50 degrees F. Materials shall be stored according to manufacturer's recommendations. Exhibit cases shall be allowed to acclimate to the building temperature for 24 hours prior to

installation.

#### 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

### PART 2 PRODUCTS

#### 2.1 COLOR

Finish colors for required items shall be as specified in Section 09915 COLOR SCHEDULE .

#### 2.2 MATERIALS

All exhibit case components must be chemically stable and non-corrosive. Materials unsuitable for use in exhibit casework include:

Materials containing sulfur: wool, wool felts, leather, rubber adhesives, rubber, rayon fabrics, hide glue, fabric dyes containing sulfur.

Hardwoods, particularly oak.

Wood panel products containing formaldehyde.

Plastics composed of polyvinyl chloride materials.

Glues, paints and plastics containing polyvinyl acetates.

Paper products, including paper, cardboards, mattboard and masonite, which are not acid-free.

Solvent-based finishes.

##### 2.2.1 Glass

Glass for door panels shall be 3/8 inch thick clear white laminated safety glass offering protection against UV damage. Glass shall be in accordance with ANSI Z97.1 and shall conform to ASTM C 1172.

Glass for shelving shall be 1/4 inch thick regular tempered float glass in accordance with ANSI Z97.1 and shall conform to ASTM C 1048.

##### 2.2.2 Medium Density Fiberboard

Case back, side and bottom panels shall be 3/4 inch thick 100% formaldehyde-free industrial grade medium density fiberboard, manufactured with a formaldehyde-free binder and which meets the requirements of ANSI A208.2-1994, product class MD.



### 2.2.3 Metal Finishes

Finishes for aluminum and steel components shall be two-component waterborne-polyurethane.

### 2.2.4 Case Lining

Case back, side and bottom panels shall be wrapped with natural 100% linen fabric.

## 2.3 FULLY RECESSED WALL DISPLAY CASE

Display case shall be sized as indicated, and shall be fully recessed within the wall cavity, with front glass face flush with the wall face. Case shall be equipped with one pair of locking hinged doors with 3/8 inch laminated glass secured in aluminum channels at top and bottom of doors. Doors shall be of framless construction with no intermediate vertical support. In closed position, adjacent glass panels shall remain in one plane.

Top and bottom rails shall conceal dual action hinge manufactured from high-strength aluminum requiring no lubrication. When unlocked, the door panel shall release from the compression seal and rotate out and away from the display space to provide full access. The pivot end shall not rotate into the display case.

Structural components and fasteners shall be concealed. Locking shall be provided by means of pin tumbler cylinder locks.

Case shall be provided with a perimeter silicone seal fitting securely against doors in closed position to protect contents from dust pollutants, and pest infestation.

The case interior shall be lined with linen-wrapped removable medium density fiberboard panels.

Each case shall include three (3) 1/4 inch thick tempered float glass shelves on stainless steel brackets mounted on stainless steel shelf standards, concealed by back panels.

Bottom panel of case shall be removable and shall provide access to a dessicant compartment containing a silica gel dessicant.

Top of case fluorescent lighting, accessible through removable lighting diffuser top panel.

## 2.4 PEDESTAL DISPLAY CASE

Pedestal display case shall be sized as indicated. Case shall be 3/8 inch laminated glsas on all four (4) sides and top with mitered joints. Base shall constructed of painted 3/4 inch medium density fiberboard panels supported by painted steel internal frame with levelers. Base shall include a locking hinged panel accessing a drawer mounted underneath the display housing a dessicant compartment with a silica gel dessicant.

Glass portion of case shall have one locking hinged door with 3/8 inch laminated glass secured in aluminum channels at top and bottom of doors. Door shall be of framless construction with no intermediate vertical support. In closed position, adjacent glass panels shall remain in one plane.

Top and bottom rails shall conceal dual action hinge manufactured from high-strength aluminum requiring no lubrication. When unlocked, the door panel shall release from the compression seal and rotate out and away from the display space to provide full access. The pivot end shall not rotate into the display case.

Structural components and fasteners shall be concealed. Locking shall be provided by means of pin tumbler cylinder locks

The case bottom shall a linen-wrapped removable medium density fiberboard panels.

### PART 3 EXECUTION

All openings dimensions shall be field verified prior to fabrication of cases.

#### 3.1 INSTALLATION

Installation and assembly shall be in accordance with manufacturer's printed instructions. Concealed fasteners shall be used. Exhibit cases shall be attached to the substrate with suitable devices to anchor each unit. The Contractor shall furnish and install trim items, accessories and miscellaneous items in total, including but not limited to hardware, grounds, clips, backing materials, adhesives, brackets, and anchorages incidental to or necessary for a sound, secure, complete and finished installation. Installation shall not be initiated until completion of room painting and finishing operations. Exhibit cases shall be installed in locations and at mounting heights indicated. Exhibit cases shall be installed level and plumb, and if applicable doors shall be aligned and hardware shall be adjusted. Damaged units shall be repaired or replaced by the Contractor as directed by the Contracting Officer.

#### 3.2 CLEANING

All surfaces shall be cleaned in accordance with manufacturer's instructions.

-- End of Section --

SECTION 11130  
AUDIO SYSTEM

## PART 1 - GENERAL

## 1.1 GENERAL DESCRIPTION

The Project described herein is Conmy Hall Renovation, Fort Myer, Virginia. The purpose of this section is to provide Specification for sound reinforcement, audio playback, monitoring, recording and production support systems to be installed in Conmy Hall and related ancillary spaces within the Project.

## 1.2 RELATED DOCUMENTS

The Contractor shall read, review and understand all documents listed below prior to bidding or proceeding with work. The Contractor shall also refer to and understand all other related documents indicated herein:

1.2.1 This section of the specification.

1.2.2 Applicable provisions of Division 1 shall govern all work under this section.

1.2.3 In addition to the conditions and work described herein, all conditions of the Contract shall apply.

1.2.4 AV Equipment Schedule, observing

(A) Product descriptions, manufacturers' names and model numbers.

(B) Quantities are to be confirmed by Bidder for base pricing.

1.2.5 AV Drawings: AV Systems drawings included schematics, elevations, sections and details are designated as "AV".

1.2.6 EA Drawings: Electrical power, grounding and conduit drawings supporting the AV Systems are designated as "EA".

## 1.3 DEFINITIONS

(A) "ADA" - Americans with Disabilities Act.

(B) "Ancillary Equipment Rack" - The moveable equipment rack with equipment serving the main mixing console.

(C) "Architect" - AMOS BAILEY ARNOLD + ASSOCIATES, INC., 300 Clipper Mill Road, Suite 300, Baltimore, MD 21211, Office: (410) 962-0505, Fax: (410) 235-3714.

(D) "ASITG" - Audio System Isolated Technical Ground.

(E) "Audio Video Panel" - Input/Output panel for audio connectors and/or video connectors. (Single-use connector panels shown on drawings are, in some instances, identified according to use.)

(F) "AV" - Audio/Video.

- (G) "AVC" - Audio/Video Systems Contractor.
- (H) "AVP" - Used herein and on Drawings to abbreviate Audio Video Panel.
- (I) "Center Cluster or Center Loudspeaker" - Loudspeakers at center of proscenium.
- (J) "Contractor" - Audio/Video Systems Contractor.
- (K) "Control Booth" - Synonymous with "Control Room". Unless otherwise noted, references that which is made part of the particular space being described.
- (L) "Control Room" - Synonymous with "Control Booth". Unless otherwise noted, references that which is made part of the particular space being described.
- (M) "Consultant" - Kirkegaard Associates, 801 West Adams St. 8<sup>th</sup> Floor, Chicago, IL 60607, ph: 312-441-1980, fax: 312-441-1981, e: acoustics@kirkegaard.com.
- (N) "Dedicated Movable Equipment" - Equipment furnished for a specific facility and not considered part of an AV equipment pool.
- (O) "Delay" - When referring to audio signal, same as "electronic delay."
- (P) "DSP" - Digital Signal Processor.
- (Q) "EC" - Electrical Contractor.
- (R) "EE" - Electrical Engineer.
- (S) "Facility-Wide" - For purposes of the Project, inclusive of the primary and the ancillary and technical support spaces.
- (T) "Floor Box" - Audio/Video/Power floor boxes.
- (U) "Furnish" - Supply, to Owner's representative, all equipment, parts or materials not requiring installation. Such equipment, parts and material may be supplied loose but shall be appropriately packaged. Excludes test equipment, et cetera, and "furnished" for use during system testing.
- (V) "GC" - General Contractor.
- (W) "He," "Him," "His," et cetera - Third-person singular used without preference or regard to gender.
- (X) "ICT" - Information Communication Technology.
- (Y) "IHMP" - In House Mixer Position.
- (Z) "Incidental" - A minor item or expense associated with this work that a reasonable person shall believe to be included without requiring explicit description.
- (AA) "IR" - Infrared.
- (BB) "Jack" - A receptacle used to make electrical low-voltage signal connections via a cord-mounted plug.
- (CC) "Left Cluster" - Loudspeakers at house-left with respect to audience members' view of stage.
- (DD) "MATV - Master Antenna Television (broadband).

- (EE) "MDF" - Master Distribution Facility (IT Head-End).
- (FF) "MIAGP" - Main Isolated Audio Ground Point (within audio equipment racks).
- (GG) "Mobile Equipment" - Generally, equipment on wheels. Considered part of an AV equipment pool furnished as part of these systems.
- (HH) "Mobile Rack" - See "Ancillary Equipment Rack".
- (II) "Movable Equipment" - Generally, equipment that may be employed at various positions but requiring infrequent repositioning, or, requiring more effort to reposition than "Portable Equipment". Considered part of an AV equipment pool furnished as part of these systems.
- (JJ) "N.I.C." - Not included in AV Systems Contract.
- (KK) "Normalled" - Connected through a patchbay so that no patch cable is required to make the subject connection. Unless otherwise noted, Insertion of patch cable breaks "normal".
- (LL) "Others" - Persons or contractors other than the Audio/Video contractor responsible for the work described by this section of the overall project specification.
- (MM) "Portable Equipment" - Generally, equipment that may be readily carried or repositioned or deployed by one person.
- (NN) "Provide" - Unless otherwise indicated, requires contractor to furnish and install.
- (OO) "specification" - refers to Request For Proposal.
- (PP) "RGBx" - refers to both RGBHV and RGBS video.
- (QQ) "Right Cluster" - Loudspeakers at house-right with respect to audience members' view of stage.
- (RR) "Terminate" - Provide end-of-line impedance matching if specifically indicated, otherwise, synonymous with "connect" or "land".
- (SS) "Volume" - Sometimes used in lieu of "level" or "sound pressure level" when the former may be confused with elevation or height and when the latter is cumbersome.

#### 1.4 SCOPE of WORK

- 1.4.1 Design and provide all described systems complete and working, according to the detailed information contained in the specification and drawings, the omission of minor details notwithstanding.
- 1.4.2 If substitution loudspeakers are requested, AV Contractor shall provide a trial installation of the Grandstand and/or Ceremony Floor loudspeaker systems for the users and Owner's representatives to evaluate.
  - (A) The Grandstand trial installation shall include the VIP seating area and one loudspeaker on either side of it spaced according to the design.

- (B) The Central-floor trial installation shall include a minimum of four loudspeakers spaced according to the design, including both east/west and north/south loudspeaker coverage overlaps.
- 1.4.3 Installation shall be complete one month prior to the project completion date.
- (A) One week following the completion of installation may be used for system testing and verification by the AV Contractor.
  - (B) The following week shall be reserved for testing and verification by the Owner's representative.
  - (C) The final two weeks prior to the completion date shall be reserved for event rehearsals, punch list completion and any required re-testing.
- 1.4.4 Contractor shall provide the following in accordance with the Specification and Drawings:
- (A) Submittals as described hereinafter. Furnish catalog sheets, color and material samples for approval only upon request by Owners' representatives.
  - (B) Do not furnish catalog sheets for equipment listed as the basis for design. Do furnish catalog sheets for requested substitutions and other AV Contractor selected equipment.
  - (C) Verification of dimensions and other conditions at project site.
  - (D) AV equipment, accessories and mounting hardware.
  - (E) Control equipment and accessories.
  - (F) Cabling, wiring connectors, connector panels and accessories.
  - (G) Equipment racks and associated accessories.
  - (H) Power distribution within equipment racks.
  - (I) Incidentals necessary for a complete working system.
  - (J) Initial testing and adjustments, demonstration of system for approval, participation in acceptance tests, final adjustments as required.
  - (K) Record Documents.
  - (L) Instruction of operating personnel.
  - (M) Maintenance services for one year following acceptance of system.
- 1.4.5 Provide insurance fully covering all equipment against loss and damage during shipment, storage, installation, testing, adjustment and demonstration.
- 1.4.6 Furnished Under Other Sections of this specification
- Related work specified elsewhere or provided by Owner:

- (A) All conduit, cable trays, junction boxes, pull boxes, outlet boxes, installation of floor boxes and 70V system loudspeaker backboxes.
- (B) All project AC power, including but not limited to:
  - (1) Dedicated Audio AC power system.
  - (2) AC power to individual equipment racks from dedicated AC power system.
  - (3) AC power receptacles not within equipment racks but dedicated for audio use and served by the dedicated AC power system.
  - (4) Audio System Isolated Technical Ground (ASITG) conductors from Main Building Technical Ground Points to Main Isolated Audio Ground Points (MIAGP) in AV equipment racks.
  - (5) All architectural millwork required in support of the AV systems.

#### 1.5 INCLUSION IN BID DOCUMENTS

Applicable provisions of Division 1 and General Bidding Requirements shall govern the Audio System bid submission.

- 1.5.2 Submit with proposal, documentation verifying the AV contractor's experience in designing, fabricating and installing audio/video systems of similar scope and size to that of this project. Submit a list of no fewer than ten systems, including three systems comparable to this project in size and complexity and installed by the AV Contractor in the past five years. Provide a brief description of each of those three projects.

#### 1.6 SUBMITTALS

An AV Systems submittal is required as specified below. The submittal will be reviewed by the AV Consultant.

- 1.6.1 Partial Submittals may be rejected.
- 1.6.2 Submit all materials for review as described below, referenced to the specification paragraph number (where applicable).
- 1.6.3 Submit ONLY two copies for AV Consultant review (photocopies are acceptable). Additional copies may be required by Division 1 or other authorities. AV Contractor to verify the total number of copies required with the Architect.
- 1.6.4 Submit all major drawings on sheets of one size, preferably 30"H x 42"W or on 11" x 17" if that size allows for legibility of the drawing.
- 1.6.5 Where materials are presented on sheets 11" x 17" or smaller, organize into three-ring binders which include:
  - (A) Dividers or tabs between logical sections
  - (B) Project name and binder title labels on face and edge of binders
- 1.6.6 Submit all minor drawings on sheets of one size.

- 1.6.7 Maintain 3/32" minimum lettering height wherever possible. Submittals with text less than 1/16" in height may be rejected.
- 1.6.8 Provide the following documentation for review by Owner's representatives after award of Contract and prior to purchase, fabrication, assembly and installation of equipment and materials.
- Provide schedule of work with milestones for following tasks:
- (A) Submittal deadlines.
  - (B) Shop fabrication complete.
  - (C) Shop testing.
  - (D) Shipment to site.
  - (E) Installation.
  - (F) Initial testing.
  - (G) Training
  - (H) Rehearsal Dates.
  - (I) First Public Event Date.
- 1.6.9 Personnel
- Provide, in writing within two weeks after award of Contract, names, mailing address, phone numbers with extensions, email addresses and paging service numbers (if available) of following project personnel:
- (A) Administrative Project Manager.
  - (B) Technical Project Manager.
  - (C) Service and Installation Manager(s).
  - (D) Field Foreman.
- 1.6.10 Conduit Verification
- Within 60 days of award of contract, AV Contractor will verify that the conduit system as drawn in the EA drawings is adequate for the designed systems. If it is not adequate, specific changes are to be listed in writing and distributed to project management which will make it adequate.
- 1.6.11 Shop and Field Drawings
- Provide the following Shop and Field drawings for review and approval prior to purchase, fabrication or assembly of equipment:
- (A) Detailed system wiring diagrams showing all wire-tag numbers or nomenclature to be used in the assembly shop or in the field.
  - (B) Arrangement and circuiting of AC power distribution within AV equipment racks and on/off sequencing.
  - (C) Detailed cable management drawings and including termination at junction boxes and equipment racks.
  - (D) Shop drawings of all custom assemblies such as racks, panels, et cetera.



- (E) Design of MATV distribution system.
- (F) Mounting and installation details of AV equipment requiring integration with cabinetry or other architectural elements.
- (G) Details, stamped and signed by an appropriately licensed engineer, of all equipment mounting methods and materials provided by the Scope of Work, wherein failure of method or materials used for mounting or hanging permanently installed equipment could result in serious personal injury.

Details provided by or requiring approval by licensed engineer may include: method of attachment to building structure or attachment and/or suspension points; method of attachment to supported equipment; all suspension materials; a materials list including specifications of all suspension materials; calculations used to determine loads and strengths of suspension materials; other as deemed necessary by the engineer.

In the absence of submitted approved, stamped and signed mounting and hanging details, the Owner reserves the right to acquire such engineering approval at the expense of the Contractor. Owner shall notify Contractor of such intent. Contractor shall remedy within two weeks or Owner may proceed without Contractor approval and without relieving Contractor from any other obligations set forth by Contract.

- (H) Color and finish samples as required by this specification and, additionally, as may be requested by Owners' representatives.
- (I) Catalog sheets as required by this specification and for products where Contractor has choice allowed by this specification.

#### 1.7 PRELIMINARY PERFORMANCE REPORT

Submit at least one week prior to final acceptance testing. See section below for required items for inclusion in the report.

#### 1.8 REQUESTS FOR SUBSTITUTION

- 1.8.1 Substitutions requested by Contractor before and/or after the Contract award shall be in accordance with the General Conditions.
- 1.8.2 Requested substitution must be approved prior to purchase, fabrication or assembly of related equipment
- 1.8.3 All requests for substitution must include documentation establishing equal or better performance of substitution equipment.

#### 1.9 APPROVALS

- 1.9.1 Proceed at own risk with work until the documents required by this Section are submitted, received and returned with stamped approval.

1.9.2 Receive approval from Architect and Owner prior to publication of any references, articles, and/or acknowledgments.

1.10 RECORD DOCUMENTS

1.10.1 Operating and Maintenance Data Manuals

Submit three Operating and Maintenance Data Manuals bound in heavy duty locking binders with steel hinges. Binders shall include heavy duty dividers and contain the following sections:

- (A) Table of contents.
- (B) Updated system functional descriptions.
- (C) List of provided equipment, material, accessories, and loose items including quantities.
- (D) Manufacturers' descriptions and specification sheets arranged alphabetically by manufacturer and then by model number.
- (E) Complete instructions including:
  - (1) System-specific operating instructions written by the contractor to instruct current and future users how to run the system whether or not they have had the benefit of site training or oral history.
  - (2) Equipment-specific operating instructions including manufacturers' operating manuals arranged alphabetically by manufacturer and then by model number.
  - (3) Tabular, graphic, or photographic record of settings and adjustments of semi-fixed controls.

1.10.2 Xerographic copies of "As-Built" block and detailed wiring diagrams in protective pockets reduced to 11" x 17" as necessary.

1.10.3 Xerographic copies of relevant "As-Built" conduit diagrams in protective pockets reduced to 11" x 17" as necessary.

1.10.4 "As-Built" conduit-fill schedules or Xerographic 11" x 17" copy (or reduction) of conduit fill diagrams.

1.10.5 Test reports.

1.10.6 Key Schedule.

1.10.7 Copies of warranty amendment letters.

1.10.8 Copy of this specification.

1.10.9 System "As Built" Drawings.

Upon completion of the project and final acceptance of the installation, update original drawings to accurately reflect the as-built conditions of all required modifications, executed change orders or other field conditions.

Provide two xerographic sets at Project's standard drawing size. Maintain 3/32" minimum lettering height wherever possible and allow no lettering less than 1/16" in height.

Include the following drawings:

- (A) System block diagrams.
- (B) Rack layouts.
- (C) Patchbay layouts.
- (D) Terminal block layouts.
- (E) Detailed wiring diagrams including wire tag numbers and wire color codes.
- (F) Other relevant drawings as appropriate.
- (G) Posted Operating and Maintenance Instructions

Provide and post at each equipment rack location and equipment backboard, mounted behind glass or acrylic plastic, a bond-paper xerographic (not blue-line) reproduction of the following:

- (1) Instructions indicating the method and/or sequence for powering the system on and off.
- (2) System block diagram. If large paper (24"x36" or larger) is used, laminate, fold and store in protective envelope in back of equipment rack at the Rack Room. Provide heavy-duty envelope(s), as required.

1.11 QUALITY ASSURANCE

1.11.1 Contractor Qualifications

- (A) To qualify as an AV Contractor, a contracting firm shall have been, for at least the past five years, in the business of providing systems comparable to those described by the Audio System specification.

1.11.2 Field Personnel

- (A) When such training is available, Technical Project Manager and Field Foreman shall be factory trained in installation and adjustment of specified equipment prior to commencement of installation.
- (B) Maintain the same individual in charge of work throughout execution unless illness, loss of personnel, or other circumstance(s) beyond the control of the Contractor intervenes. Immediately inform Architect, Consultant, GC, EC, ICT Contractor and Owner's Representative, by fax or email, of change of individual in charge.

1.11.3 Coordination

- (A) Coordinate the work of this section with work of other specification section and associated trades.
- (B) Specific references, herein, requiring coordination of certain work shall not obviate responsibility for other required coordination.

1.11.4 Contractor shall

- (A) Verify correctness of Equipment Schedule with regard to quantities and model numbers.
- (B) Verify dimensions and other relevant conditions at site prior to installation.
- (C) Review conduit system as shown in electrical section of building construction documents and, where applicable, as built.
- (D) Notify Consultant, Architect, GC, and EC of deficiencies or inadequacies in conduit system design as represented on the EA drawings.
- (E) Notify appropriate parties of conflicts in timely manner.
- (F) Work cooperatively with other trades to resolve conflicts.
- (G) Furnish specified submittals in a timely fashion.
- (H) Meet requirements and milestones of project schedule.
- (I) Use equipment in the manner specified.
- (J) To the greatest extent possible, assemble and wire equipment racks off-site.
- (K) "Burn-in" or "Break-in" electronic equipment for 72 hours minimum.
- (L) Replace failed equipment.
- (M) Repair or replace with approved alternate, new components found not to meet manufacturers' specifications, with resultant adverse effect on the installation.

#### 1.11.5 Standards and Codes

- (A) Comply with local, state and federal codes and applicable National Electrical Code, American National Standards Institute and Underwriters' Laboratories, Inc. standards.
- (B) All equipment, material, accessories, and loose items furnished shall be new and shall conform to applicable requirements of the above-mentioned agencies.
- (C) If required by local authorities, provide certificates and labels indicating compliance with above-mentioned codes and standards where applicable.

#### 1.12 TESTING

##### 1.12.2 Submit preliminary performance test report at least one week prior to final testing.

- (A) Preliminary Performance Testing to include:
  - (1) Verification of the proper installation of all power and grounding systems.
  - (2) Verification of the signal integrity of all signal paths.
  - (3) Verification of the proper operation of all installed AV Equipment.

- (4) Verification of the programming and operation of the Control System.
  - (5) Verification of the programming and operation of the DSP.
- 1.12.3 Equipment shall be operated under standard conditions as recommended by manufacturer during performance testing.
- 1.12.4 Final Acceptance Testing shall be performed in presence of Owner's representative to demonstrate acceptability of project as installed.
- 1.12.5 Repair conditions caused by defective workmanship.
- 1.12.6 Replace defective material and equipment.
- 1.12.7 Re-testing may be required to demonstrate compliance with drawings and specification.
- 1.13 WARRANTY and TECHNICAL SUPPORT
  - 1.13.1 One Year Warranty
    - (A) Contractor shall warrant the system against failure resulting from defects in material or workmanship for a period of one year from final acceptance by Owner.
    - (B) If the manufacturer of any equipment used in these systems provides less than a one-year warranty for that equipment, Contractor shall assume warranty responsibility for the balance of the one-year period not covered by the manufacturer.
    - (C) Within warranty period, Contractor shall make necessary repairs and replacements at the convenience of and at no cost to Owner. Within warranty period, provide prompt replacement of defective materials and repair of faulty workmanship at no cost to the Owner.
    - (D) Paint, exterior finishes, fuses and lamps are excluded from guarantee except when damage or failure results from defective materials covered by guarantee.
  - 1.13.2 On-Site Service
    - (A) Provide, at no cost to Owner, maintenance service during above mentioned warranty period. At minimum, this service shall include one visit to the site at six months, and one visit two to four weeks prior to expiration of the warranty period for checking AV systems and equipment. Perform standard maintenance and effect any warranty service requirements revealed during these visits. (No limitation of warranty service is intended by the instruction).
    - (B) During warranty period, Contractor shall answer all service calls within one business-day.
    - (C) Provide on-site service within 24 hours of notice by Owner if instructions from Contractor to Owner fail to correct system-critical faults within two hours of notice by Owner.
    - (D) Provide on-site service within 72 hours for faults determined by the Owner to be not system-critical.

Alternatively, at the discretion of the Owner, components to be removed and replaced by Owner may be transported via common carrier shipments.

1.13.3 Extended Warranty Option

Provide separate prices for the Owner to purchase either an additional 12 months (total 24 months) or 24 months (total 36 months) of Extended Warranty.

If Owner accepts any Extended Warranty Option, fulfill the requirements of the Extended Warranty as described for original one-year warranty and according to any agreed-to special terms.

1.14 SYSTEM DESCRIPTION

1.14.1 General

This System Description supplements EA Drawings, AV Equipment Schedule and related architectural, electrical and other drawings.

1.14.2 Design and provide new audio/video equipment interfaced with the existing and new conduit and power systems (provision of the latter two systems, N.I.C.).

1.14.3 All system equipment to be of high-quality professional grade. (The equipment listed as the design basis for this specification exemplifies this criteria with respect to each system element.)

1.14.4 Audio system to be "user-friendly" while meeting the functional requirements of the system.

1.14.5 Audio/Video Subsystems

(A) General Requirements

Design and provide an audio reinforcement and playback system that shall serve the following uses:

- (1) speech reinforcement of announcements, narrations and presentations.
- (2) program playback to accompany ceremonies.
- (3) live music reinforcement for performances requiring amplification.

(B) Design and provide the following subsystems to support ceremonies:

- (1) Production Intercom for communication among the technical staff.
- (2) Monitor/Page to provide paging and performance monitoring to public spaces and backstage areas, including the marshalling area behind the Hall.
- (3) Hearing Assistance to provide a wireless amplification system for the Hearing Impaired in compliance with Section 504 of the Rehabilitation Act of 1973 and any applicable amendments.

- (4) Composite-video infrastructure for distribution of video signals.
- (5) Microphone splitters to supply microphone signals to broadcast/recording facilities and the occasional use of a monitor mixing console (monitor mixing console NIC).
- (6) Portable press-patch boxes to interface with permanent infrastructure to provide microphone or console feeds to press recording facilities.
- (C) Design and provide installed cabling and connector panels for connectivity to support the program requirements described above.
- (D) Design and provide additional installed cabling and connector panels (AVPs) for connectivity to support the following requirements:
  - (1) Loudspeaker patching for portable sound effects and stage monitor loudspeakers throughout the Hall.
  - (2) Network patching to route data signals throughout the Hall and to connect the Hall to the facility-wide data network.
  - (3) Fiber-optic patching to route AV signals throughout the Hall.
- (E) Microphones
  - (1) Provide a complement of wired microphones, stands and cables to accommodate the ceremony and presentation requirements outlined above.
  - (2) Provide a dedicated stereo microphone in the Hall that shall serve as the source for archival recording and for inputs to the Monitor/Page and Hearing Assistance Systems.
  - (3) Microphone Splitter Rack to house the wireless systems described below for normal use at the house mixing position.
    - (a) Eight (8) systems of professional-quality wireless microphones including bodypack and handheld transmitters.
    - (b) 4- Active directional antennas for permanent wall mounting.
    - (c) Diversity antenna splitter for routing active directional antennas from AVP to permanently mounted receivers in Microphone Splitter Rack.
    - (d) Ten (10) omnidirectional "mini-lav" microphones with mounting accessories.
- (F) Main Mixing
  - Provide a Main Mixing Console for use at the house mixer position. Main Mixing Console shall include, at least:

- (1) Left-Center-Right main outputs assigned from input channels. L/R and Center assignments shall be separate on each input channel.
  - (2) 40 or more microphone-level input channels, eight individually assignable groups, eight auxiliary sends, 11 x 4 matrix, 128 mute scenes and four stereo inputs.
  - (3) Four-band EQ on all input channels with a minimum of two parametric bands and having EQ in or out selection on all channels.
  - (4) Eight VCA groups.
- (G) Ancillary Equipment Rack
- (1) Provide a rolling rack, installed equipment, patchbays, patch cables, AV Panel, power panel and multi-pair cables for the Ancillary Equipment Rack.
  - (2) The Ancillary Rack is located at the mixing position and is connected to the AV Panel and Main Mixer via supplied multi-pair cables. The Ancillary Rack may also be connected to the Equalizer Rack via supplied multi-pair cables when the Equalizer Rack is at the house mixing position. All rack inputs and outputs are available via in-rack patching as are the I/O of the Equalizer rack, when connected. Ancillary Rack to include:
    - (a) Patch points for all mixer group, auxiliary, main and matrix outputs,
    - (b) Patch points for all mixer stereo line-level inputs and all in-rack line level equipment,
    - (c) Patch points for all Equalizer Rack inputs and outputs,
    - (d) (1) Auto-pause CD player with balanced outputs, example: Marantz PMD331,
    - (e) (1) Stereo Multi-function effects processor, example: Lexicon MPX-550 or TC Electronic M1-XL,
    - (f) (2) Dual-channel compressor/limiter, example: dbx 1066,
    - (g) (1) Dual-channel 1/3 octave graphic equalizer, example: Ashly GQX-3102,
    - (h) (1)DVD for the playback of video sources, example: Marantz PMD930,
    - (i) (1)DVD Recorder for the recording and playback of video sources, example: Panasonic LQ-DRM200,
    - (j) (1) Intercom Remote Station.
    - (k) (1) Rack-mounted operating light, example: Littlelite RL-10D.
    - (l) Audio-system sequenced power on/off switch with key lock. Outlet power sequencing is brought to



the Ancillary rack from the mix position floor boxes.

(H) Equalizer Rack

- (1) Provide a rolling rack, installed equipment, AV Panel, power panel and multi-pair cables for the Equalizer Rack.
- (2) The Equalizer Rack may be used at the house mixing position or on the ceremony floor as part of a monitor-mixer system (latter, N.I.C.) or a rental system (also, N.I.C.). Multi-pair cables and fanout cables shall facilitate the use of the Equalizer Rack in both either location depending on the needs of the event. Equalizer Rack to include:
  - (a) (2) Dual-channel compressor/Limiter, example: dbx 1066.
  - (b) (1) Dual-channel parametric equalizer, example: Ashly PQX-572.
  - (c) (4) Dual channel 1/3 octave graphic equalizer, example: Ashly GQX-3102.
  - (d) (1) Rack-mounted operating light, example: Littlelite RL-10D.

(I) Microphone Splitter Rack

- (1) Provide a rolling rack, installed equipment, AV Panel, power panel and multi-pair cables for the Microphone Splitter Rack:
  - (a) The Microphone Splitter Rack is normally at the mixer position and is connected to the AVP and Main Mixer via supplied multi-pair cables.
  - (b) The Microphone Splitter rack contains microphone patching facilities and 40 channels of microphone splitting with each channel having three outputs and integrated phantom power.
  - (c) (1) Rack-mounted operating light, example: Littlelite RL-10S.
  - (d) Wireless mic antenna splitter and wireless microphone receivers (8) are mounted in the Microphone Splitter rack. The remote antenna feeds must be connected to the rack from the mix position floor boxes.
  - (e) Outlet power sequencing is brought to the Microphone Splitter rack from the mix position floor boxes.

(J) Amplifier Racks

- (1) Provide stationary rack(s) as required, installed equipment, patchbays, patch cables, AV Panel and power panel for the Amplifier Rack(s):
- (2) The Amplifier Rack is located in the amplifier room, which is located above the control booths. It shall

NOT be located with the lighting dimmers or other high-amperage electrical equipment. Amplifier Rack to include:

- (a) Patch points for all mixer group, auxiliary, main and matrix outputs,
- (b) Patch points for all audio tie-lines, video lines, monitor/page inputs, network lines,
- (c) Audio distribution amplifiers for each zone in the grandstand and central-floor loudspeaker systems,
- (d) Digital signal processing (DSP) for main audio system and for monitor/page system. Main DSP to have computer or software controller connection at amplifier rack and house mixing positions,
- (e) Amplifiers for monitor and effects loudspeakers and monitor/page system,
- (f) Amplifiers for central-floor fill loudspeakers,
- (g) Minimum of two 1 x 6 video distribution amplifiers with patch points in video patch bays,
- (h) Hearing Assistance System transmitter, input connected to patchbay,
- (i) AV panel to include audio tie-lines and intercom connections,
- (j) Power sequencing equipment for AV isolated-ground power circuits to be switched in the proper order during power-on and power-off. Include system power on/off switch in rack panel.

(K) Loudspeaker Systems

(1) Grandstand Loudspeakers

- (a) The grandstand loudspeakers shall be mounted to the underside of the lighting truss, where available, and to the underside of the roof truss where required.
- (b) The grandstand loudspeaker system shall be controlled in five zones via the main DSP. The zones are one for each side section (2) and (3) across the center section. The three center section zones are assigned to the left, center and right mixer master outputs and the side zones are each assigned to one of the mixer group outputs. Each zone's signal shall be divided to provide individual signals to each loudspeaker in the zone using individual DSP outputs in the amplifier rack.

(2) Central-floor Loudspeakers

- (a) The central-floor loudspeaker system shall consist of loudspeakers mounted to the underside of the lighting truss structure.
  - (b) The central-floor loudspeaker system shall be controlled in four zones via the main DSP. The zones shall be configured as for zones front to back. Each zone's signal shall be divided to provide individual signals using individual DSP outputs in the amplifier rack.
- (3) Monitor and Effects Loudspeakers
  - (a) Provide portable stage monitor and effects loudspeakers and amplifiers for use in conjunction with the connectivity systems (described hereinafter) to support performances and presentations, minimum of four of each type.
- (L) Digital Signal Processing
  - (1) Install Digital Signal Processing (DSP) equipment to control the grandstand loudspeakers, subwoofers, central-floor loudspeakers, hearing assistance and monitor/page systems.
  - (2) Loudspeaker zones within the programming shall be adjustable via a graphically intuitive user interface via a programmable control interface and touch-screen. Touch-screen to be located at house mixer position and permanent infrastructure provided to connect to DSP in amplifier rack.
  - (3) In addition to signal routing and splitting the DSP shall provide the following processing functions in support of the audio system.
    - (a) Microphone pre-amplification for house stereo microphone.
    - (b) Parametric equalizers for each output channel.
    - (c) Limiters for each output channel.
    - (d) Input and output delays for use in signal alignment.
    - (e) Page override ("ducking") for use with monitor/page system.
    - (f) Control input facilities for connection of computer or other control interface equipment.
    - (g) Auto-mix mode for utility system operation.
    - (h) Feedback suppression processors.
    - (i) Multiple preset capacity.
    - (j) Ability to be controlled by touch screen control interface
    - (k) Routing of logic and switching signals.
  - (4) All DSP power is connected to UPS power supply to protect processors against short-term power failure.

- (5) DSP processors communicate to each other through a dedicated Ethernet switch, used for no other purpose.
- (M) Monitor/Page System
  - (1) The Monitor/Page System shall provide one-way, amplified communication from paging microphone locations to backstage areas, the marshalling area and public spaces. Public spaces include the lobby, public restrooms and VIP lounge. Backstage spaces include the control booth, offices.
    - (a) Marshalling area shall be able to be independently controlled from monitor/page control stations.
  - (2) The System shall be capable of providing backstage and public spaces with performance monitoring in addition to announcements.
  - (3) Chime recall shall be provided for the public spaces.
  - (4) Volume controls for the offices, VIP lounge, control booth and vocal booth shall be local to those areas. Volume control for the lobby, public restrooms and marshalling area shall be centralized.
  - (5) Under normal operation, local volume controls for program audio shall control the volume in the individual spaces without affecting the volume of page announcements.
    - (a) The control booths shall have page defeat switches for use when a page signal might bleed into the hall or interrupt a narration.
- (N) Production Intercom
  - (1) Design and provide a six-channel, two-way intercom system for production communication during performances. The stage manager shall be able to communicate on any channel independently or simultaneously. The main station shall be located in the amplifier racks. Remote stations shall be located at the house mix ancillary rack and in the mobile stage manager rack. The mobile state manager rack can be connected in the control booth or at two locations around the ceremony floor.
  - (2) Stage Manager shall be able to page into the Monitor/Page System from the headset microphone.
  - (3) Portable intercom loudspeaker stations may be used with the Production Intercom System. (NIC)
  - (4) Provide beltpack intercom stations with single-muff headsets for connection to intercom infrastructure.
  - (5) Provide handsets for use with intercom system.
  - (6) Provide a wireless intercom base station with two wireless transceivers and associated rechargeable battery packs and chargers.

- (O) Hearing Assistance System
  - (1) Design and provide a wireless, radio-frequency, Hearing Assistance System.
  - (2) Provide receivers in quantity to comply with the Rehabilitation Act of 1973 and applicable amendments.
  - (3) Provide rechargeable batteries at 125% of the number of receivers and battery charger stations at 5% of the number of receivers.
  - (4) Provide extra earpiece covers, neck loops and other accessories to provide a range of user options to facilitate convenient use of the hearing assistance system.
- (P) Camera and DSP Control Systems
  - (1) Provide a remote control system operated from a touch screen at the in-house mix position.
  - (2) Control system will provide remote pan/tilt and zoom control of the house video camera.
  - (3) Control system will provide selection of "Full System" and "Utility" audio system presets of the DSP. "Full System" uses the main mixer as its control surface. "Utility" provides minimal control of the system through the touch panel and DSP; use of the main mixer is not required in this mode.
- (Q) Connectivity Systems
  - (1) Microphone Lines
    - (a) Design and provide microphone inputs at selected locations that are available through single-circuit and multi-pin connectors as shown on AV3.01-AV3.05. Route these microphone lines through patching facilities in the microphone splitter rack to the microphone splitter.
    - (b) Design and provide a 40 input, three output (per input), microphone splitter. Each of the three output sets shall be available via a multi-pair connector on the AV panel of the microphone splitter rack. The splitter shall provide one direct output and two isolated outputs per input. The splitter shall be capable of providing phantom power. Multi-pin connectors to send microphone signals to the house mixer position or to upstage right or left and may be connected to any of the splitter outputs via flexible multi-pair resident at the splitter rack.
    - (c) Microphone splits may be used to connect to an onstage monitor-mixing console or broadcast feed via the connection of breakout cables which are part of the AV system.

- (d) Four AV Panels in the system shall have 12 microphone lines available on them. On each of these panels four of the microphone lines may be used via single cable connections. Those four connections are duplicated in a multi-pair cable plugging box which carries all 12 signals at the panel.
  - (e) Fixed Recording/Monitoring Microphones: provide dedicated lines for a stereo microphone located at the front of the control booth and route to a microphone pre-amplifier in the DSP. Example: Audio-Technica AT825.
- (2) Line-Level Audio Tie-Lines
- (a) Design and provide line-level audio "Tie-Lines" (sometimes called "loops") around the central-floor and around the Hall at selected locations to serve as multi-purpose audio interconnection lines.
  - (b) Access to and routing of tie-lines shall be provided via patching facilities at the amplifier rack.
  - (c) Audio tie line connections at AV panels shall provide paralleled XLR-male and XLR-female/TRS combo jacks.
- (3) Loudspeaker Feeds
- (a) Provide Neutrik "Speakon" loudspeaker receptacles for portable sound effects and stage-monitor loudspeakers around the central-floor and behind the grandstand.
  - (b) Design and provide a loudspeaker patch panel at the amplifier rack for routing power amplifier outputs to these receptacles.
  - (c) Include loudspeaker signal splitters in the loudspeaker patch panel.
  - (d) Cross-wire the patch panel and patch cables with Speakon NL4 connectors so that the amplifier outputs use two connectors and the loudspeaker connection uses the other two. This wiring approach is to prevent connecting amplifier outputs to each other. Clearly label the patch panel. "USE ONLY CUSTOM CROSS-WIRED PATCH CABLES". Label the loudspeaker patch cords. "PATCH CABLE ONLY".
- (4) Video Distribution
- (a) Provide video jacks at various locations around the central-floor and behind the grandstand for use with composite video signals from and to cameras, monitors, video recorders, et cetera.
  - (b) Provide interconnecting video cables.

- (c) Provide video-signal patching facilities.
  - (d) Provide a minimum of three 1x6 video distribution amplifiers; terminate inputs and outputs at patching facilities.
  - (e) Provide a permanent color video camera at the front of the control booth aimed to produce a full-floor shot for distribution throughout the Hall and ancillary spaces. The camera shall provide remote control of pan, tilt and zoom functions controlled through the programmable interface touch-screen at the house mixer position. Camera view is monitored through the control touchscreen.
  - (f) Provide a path through the video patchbay for a split of the house video-camera signal to be sent to the Video Recorder at the house mixer position for recording via supplied video distribution amplifier.
  - (g) Provide a path through the video patchbay for a split of the house video-camera signal to be sent to the MATV head-end.
- (R) MATV System.
- (1) Provide an MATV system for the distribution of video with audio signals for production coordination and distribution to public spaces.
  - (2) AV Contractor to design MATV distribution network and submit to AV Consultant for approval.
- (S) AV Network.
- (a) Provide network jacks at various AV Panels as shown on Panel Elevations.
  - (b) Provide network-signal patching facilities.
  - (c) Provide interconnecting network patch cables.
  - (d) Provide an 8-port Ethernet switch connected to the network patchbay.
  - (e) Provide a wireless 802.11g access point connected to the network patchbay.
  - (f) Connect DSP Ethernet control port to network patchbay.
- (T) Fiber-Optic Network.
- (a) Provide fiber-optic jacks at various AV Panels as shown on Panel Elevations.
  - (b) Provide fiber-optic patching facilities.
  - (c) Provide interconnecting fiber-optic patch cables.

## 1.15 PERFORMANCE REQUIREMENTS

### 1.15.1 General

- (A) Certain of the AV system's overall performance requirements may be checked readily by measurement.
- (B) The systems included in this work, as designed, are intended to meet the performance requirements stated hereinafter, based upon available data and the manufacturers' published specifications.
- (C) During the Proposal Phase, the Contractor shall have made himself familiar with the System Description stated herein, and overall system requirements and capabilities of specified equipment.
- (D) If any aspect(s) or element(s) of the affecting systems is(are) provided, other than as specified, with or without approval of substitutions or design changes, the Contractor shall be wholly responsible for fulfilling these performance requirements.
- (E) Qualifications by the Contractor relative to the ability of the specified equipment to fulfill the functional or performance requirements set forth in this Specification shall be expressed, in writing, with proposal.
- (F) Upon award, Contractor shall provide any and all equipment, material, and labor required to provide complete and operating systems in accordance with stated functional requirements.

#### 1.15.2 Frequency Response and Sound Output

- (A) Measure with "tone" controls set for flat response, using broadband calibrated pink noise applied to any microphone input for speech system or auxiliary line input for stereo system, measuring in specified bands using real-time analyzer or using specified bands of filtered pink noise centered on ANSI preferred frequencies, measuring with sound level meter.
- (B) Measure system acoustical performance using a calibrated real-time analyzer or an ANSI Standard Type 1 or IEC Precision Sound Level Meter set for "slow" meter damping and flat response at normal incidence, at a height of 4' and pointed at the loudspeakers. All interior finishes and furnishings shall be in place, and system gain shall be adjusted to provide levels of 75 to 85 dB during normal operation at the measuring locations for these tests, unless otherwise noted herein.
- (C) Unless restricted by the published specifications of a particular piece of equipment, or unless otherwise required by this specification, the following performance standards shall be met by each system:
  - (1) Set system gain to provide 85 dB SPL in measurement area during frequency response adjustments.
  - (2) Grandstand Loudspeaker Systems in Conmy Hall working in consort: with respect to a response which is flat (0 dB) from 50 to 3,150 Hz, -1 dB at 4,000 Hz, and decreases 1 dB per one-third-octave band thereafter to



-6 dB at 12,500 Hz, system response in one-third-octave bands averaged over at least six locations throughout the audience shall be adjusted to be within  $\pm 3$  dB. All loudspeakers working together.

- (3) Central-floor Loudspeaker Systems in Conmy Hall working in consort: with respect to a response which is flat (0 dB) from 100 to 3,150 Hz, -1 dB at 4,000 Hz, and decreases 1 dB per one-third-octave band thereafter to -6 dB at 12,500 Hz, system response in one-third-octave bands averaged over at least six locations throughout the central-floor shall be adjusted to be within  $\pm 3$  dB. All loudspeakers working together.
- (4) Back-of-House and Public-Space Loudspeaker Systems: with respect to a response which is flat (0 dB) from 150 to 2,000 Hz, -4 dB at 4,000 Hz, and  $-8\frac{1}{2}$  dB at 8,000 Hz, system response in octave bands averaged over at least three locations distributed throughout the areas served shall be adjusted to be within  $\pm 3$  dB.
- (5) Sound Output Capability: Systems shall be capable of producing peak program levels as specified below throughout the area served without objectionable distortion, buzz, or rattle, employing as test signals several samples of recorded speech and music.
  - (a) Grandstand, loudspeakers working together: 105 dB
  - (b) Central-floor, loudspeakers working together: 95dB
  - (c) Back-of-House and Public-Space Loudspeaker Systems: 86 dB

#### 1.16 ELECTRICAL PERFORMANCE FOR AUDIO SYSTEMS:

##### 1.16.1 Speech Reinforcement Systems

- (A) Frequency Response shall be +0 dB, - 0.5 dB from 20 to 15,000 Hz for any individual electronic component.
- (B) Signal to Noise Ratio shall be 80 dB minimum from 20 to 20,000 Hz for any individual electronic component.
- (C) Crosstalk shall be better than -60 dB from 20 to 15,000 Hz, better than -55 dB at 20,000 Hz, between adjacent channels for any individual electronic component.
- (D) Total Harmonic Distortion shall be less than 0.30% from 20 to 20,000 Hz for any individual power amplifier operating at rated power; less than 0.10% from 20 to 20,000 Hz for any other electronic audio component driven at maximum rated input.
- (E) Hum and Noise:

- (1) With building air-handling systems operating, hum and noise shall be inaudible at normal gain settings
    - (2) Measured at amplifier outputs: -80 dB or better relative to rated maximum amplifier output, with minimum of six inputs, master set at normal operating levels.
  - (F) Adjust all systems for optimum feedback stability margin.
- 1.16.2 Audio-for-Video Systems
- (A) Audio Frequency Response: 50 Hz-15 kHz 0, + 3 dB.
  - (B) Audio Wow and Flutter: 0.005% Wrms.
- 1.16.3 Electrical performance of NTSC Video Systems:
- (A) S/N (peak to RMS) unweighted dc to 4.2 MHz; 55 dB minimum.
  - (B) Crosstalk, unweighted dc to 4.2 MHz; 45 dB minimum.
  - (C) Frequency Response: within + 0.5 dB to 4.2 MHz.
  - (D) Line and Field Tilt 2% maximum.
  - (E) Differential Gain 3% maximum.
  - (F) Differential Phase 2 degrees maximum.
- 1.16.4 Performance Test Signal Paths:
- (A) Audio: Test from all source inputs (for microphones, audio tape units, et cetera) through all mixers, amplifiers, et cetera, to all signal destinations.
  - (B) Video: Test from all source inputs (for cameras, video tape units, et cetera) through all video distribution amplifiers, processors, switchers, et cetera.
  - (C) Delineation of above signal paths shall not exempt Contractor from the responsibility of checking all paths and outlets for appropriate compliance with Performance Requirements.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- 2.1.1 Refer to "Equipment Schedule".
- 2.1.2 Refer to "System Description", herein, and Contract Drawings and manufacturers' manuals for certain product use, assembly and mounting information.
- 2.1.3 For required incidental and miscellaneous products not listed in the "Equipment Schedule", the Audio Systems Contractor shall select products that satisfy the specification including "System

Descriptions", "Performance Requirements", Drawings and general product descriptions that follow.

- 2.1.4 Incidental wording of this section shall not be construed to diminish product quantities indicated by the Equipment Schedule or other Contract Documents.

2.2 MAIN SYSTEMS AND EQUIPMENT

Additional information provided below for those items with a "Y" in the "Inst." column of the Equipment Schedule.

2.2.2 Microphone for Hearing Assistance and Monitor/Page System

Stereo microphone to be mounted at AVP-M2 at Control Booth front. AV Contractor to provide mic mount capable of being aimed at ceremony floor. Standard stereo mic cable should be shortened by AV Contractor to appropriate length.

2.2.3 Microphone for Vocal Booth

Mount microphone arm bracket to counter in Vocal Booth to allow adjustment of Shure KSM32 microphone by vocal talent. Mount pop screen on arm.

2.2.4 Headphone Amplifier for Vocal Booth

Headphone Amplifier sits on Vocal Booth counter and is connected to AV panel feeds in the booth.

- 2.2.5 Control System Touch Screen should sit on the In-House Mix Position counter to the right of the mixer. Provide adequate cable for the screen to be moved to the opposite side of the mixer if desired.

2.2.6 Main Grandstand Loudspeakers

Provide (12) Main Grandstand Loudspeakers to be mounted beneath the lighting truss or the building truss system as shown on AV-500.

- (A) Loudspeakers to be self-powered. Loudspeakers to have 30 degree to 50 degree nominal vertical dispersion and 80 degree to 100 degree horizontal dispersion. Each loudspeaker to be capable of 130dB SPL. Each loudspeaker to be capable of producing 40Hz-18kHz, +-3dB. Loudspeakers must control frequency dispersion down to 500Hz by some means other than direct radiating low-frequency drivers.
- (B) Aim each loudspeaker with a downward angle of 25 degrees. Horizontal angles to be noted on AV-500.
- (C) Provide a flexible mounting method so that each loudspeaker may be adjusted +-20 degrees in either the vertical or horizontal planes.

2.2.7 Ceremony Floor Downfill Loudspeakers

Provide (18) Ceremony Floor Downfill Loudspeakers to be mounted to the underside of the lighting truss with brackets and pipe clamps.

- (A) Loudspeakers to have 90 degree conical dispersion pattern. Each loudspeaker to be capable of 110dB SPL. Each loudspeaker to be capable of producing 100Hz-18kHz, +-3dB.
- (B) Aim each loudspeaker directly down toward the floor.

#### 2.2.8 Wireless Microphone Antennas

Mount wireless microphone antennas to AVP-ANT1 locations (2) and aim directly at Ceremony Floor.

#### 2.2.9 Multifunction Digital Signal Processing

Provide a programmable Main Digital Signal Processing System to serve the various systems as outlined below

- (A) Design a complete signal-processing system utilizing virtual audio processing blocks in the Main DSP to implement a fully functional system according to this Specification, the Drawings and the Equipment Schedule.
- (B) Submit the DSP system design to the AV Consultant for approval.
- (C) Provide two programming presets for selection by the Control System. Preset One provides full access to the AV Systems' function through the operation of the Main Mixer. Preset Two allows for a simplified use of the system, without use of the Main Mixer, via the touchscreen interface. The simplified system provides automixing of the utility mic inputs and selection of loudspeaker zones from the touchpanel. The volume of utility mic inputs and master output volume may also be adjusted. The system should default to Full Access mode.
- (D) For the Main Grandstand Loudspeaker Systems provide individual DSP outputs for each loudspeaker. Each output to include signal delay, gain control, parametric equalizer and limiting.
- (E) For the Ceremony Floor Downfill Loudspeaker Systems provide grouped DSP outputs for four zones. Each output to include signal delay, gain control, parametric equalizer and limiting.
- (F) For the Backstage Monitor/Page Systems provide a mono-summed output from the stereo house mic input. Output to include automatic gain control, parametric equalizer and limiting.
- (G) For the Public Space Monitor/Page Systems provide a mono-summed output from the stereo house mic input. Output to include automatic gain control, parametric equalizer and limiting. This output also includes the Page Mic Inputs.
- (H) For the Hearing Assistance System provide a mono-summed output from the stereo house mic input. Output to include automatic gain control, parametric equalizer and limiting. This output also includes the Page Mic Inputs.
- (I) For the Marshalling Area Loudspeakers behind the Hall provide signal from the Page Mic Inputs. Processing to include gain control, parametric equalizer and limiting.

- (J) A stereo audio output from the DSP will be provided for the recording devices in the Ancillary Rack. It is derived from the stereo house microphone.
- (K) A stereo audio output from the DSP will be provided for the MATV system. It is derived from the stereo house microphone.
- (L) A stereo audio output from the DSP will be provided for the headphone amplifier in the Vocal Booth. It is derived from the stereo house microphone.
- (M) All DSP modules should be connected to an uninterruptible power supply (UPS).

#### 2.2.10 Control System

Provide Control System operated from a touchpanel at the In-House Mix Position. The Control System has two modes of operation. It is the control system for the house video camera, providing pan, tilt and zoom control, and it is the selector for the "Full Operation" or "Utility System" audio control.

- (A) AV Contractor to provide Control System programming.
- (B) In "Full Operation" mode the audio system is controlled from the Main Mixer. And the Control System defaults to camera control mode.
- (C) In "Utility System" mode the touchpanel provides control of utility system inputs and loudspeaker zone selection. The mixer does not need to be powered in this mode of operation. All controls are provided by the Control System and the Main DSP.

#### 2.2.11 Mic-Level Patchbays

Mic-level patchbays use sleeve-normals out wiring as shown on AV-100. Strapped normals or bussed normals are not acceptable for this project. Mic-level patchbays must use solder cup, ELCO/EDAC or 3-pin connections. Punch-downs are not acceptable for mic-level patchbays.

#### 2.2.12 Mic-Level Patchbays

Mic-level patchbays use lifted shields and bussed grounds as shown on AV-100. A bus bars must be installed in the Ancillary Rack to received the patchbay's bussed grounds.

#### 2.2.13 Loudspeaker Patchpanel

Wire patchpanel according to detail in AV Drawings. Panel jacks and patch cables are cross-wired to prevent accidental connection of amplifier outputs.

#### 2.2.14 Monitor/Page Loudspeaker Back Cans

Back cans for monitor/page loudspeakers to be purchased by AV Contractor and supplied to Electrical Contractor for installation by EC. Loudspeakers in lobby and connected hallways will be mounted directly to the ceiling and conduit attached to knock-outs will be exposed and painted. Loudspeakers in rest rooms,

offices and VIP lounge will be mounted into suspended ceilings using tile bridges.

#### 2.2.15 Floor Boxes

Basis of design for Floor Boxes is Ace Backstage 104BBX, see detail on EA-101. Floor box is two-deep box with the panel mounted in the middle between the boxes. This arrangement is intended to provide adequate space for the large number of cables and connections.

- (A) All AC power in Floor Boxes must be encased in ferrous metal dividers, including feeder cables.

#### 2.2.16 Provide power sequencing system so that equipment is powered on and off according to accepted professional practice. Power sequencing is extended to the Microphone Splitter and Ancillary Racks at the In-House Mix Position via connectors in the Mix Position Floor Boxes.

- (A) The mixer is not included in the power sequencing as it will not always be used.
- (B) Provide AV System power on/off switches at the amplifier rack and at the Ancillary Rack.

#### 2.2.17 Main Mixer Power Supply

Provide a stand or mounting position beneath the mixer counter for the mixer power supply which allows convenient access for power on/off and circulation of air around the top and bottom of the power supply.

### 2.3 RECEPTACLES

- (A) Use specified brand and type or approved equal.
- (B) For each receptacle-type, use same make and model throughout the project.

#### 2.3.1 Audio Receptacles

- (A) Microphone female chassis-mount connector: Neutrik NC3FDL-1.
- (B) "Tie Line" female chassis-mount connector: Neutrik NCJ6F1-S.
- (C) "Tie Line" male chassis-mount connector: Neutrik NC3MD-L.
- (D) Unbalanced "Auxiliary In" female chassis-mount RCA connector: Switchcraft 3501FP with S2207 and S1564 insulating washers (or approved equals).
- (E) Unbalanced "Auxiliary In" female 3.5mm stereo mini-jack: DGS Pro-Audio (Mouser Electronics Stock #161-3502).
- (F) Intercom male chassis-mount connector: Neutrik NC3MD-L.
- (G) Loudspeaker Receptacles: Neutrik NL4MP.

#### 2.3.2 Video and RGBx Receptacles

- (A) BNC bulkhead connectors: Kings KC-99-54.
- (B) BNC chassis-mount connector: Canare BCJ-JRU.

#### 2.3.3 Data Receptacles (for AV purposes)

- (A) RJ-45 connectors: Neutrik EtherCon series (vertical terminal blocks).

## 2.4 CABLES

- 2.4.1 Use specified brand and type from Equipment Schedule or approved equal.

- 2.4.2 For each cable-type, use same make and model throughout the project.

### 2.4.3 Audio Cables:

- (A) Individual microphone and line-level shielded-pair cable in conduit: 24 gauge (or larger) stranded conductors; low capacitance; 100% aluminum polyester foil shielding; PVC jacket: Belden 1800B or West Penn DA2401 (or equal). All mic/line cable must be AES/EBU compatible. Capacitance may not exceed 13pf/ft.
- (B) For line feeds to Grandstand Loudspeakers Harness all lines for a neat installation, leaving a service-loop at each termination facilitating aiming and servicing loudspeakers.
  - (a) Lines in conduit may be extended to loudspeakers if sheathed in black where visible to public. Absent sheathing, provide extra-flexible portable cordage; black neoprene, rubber or PVC jacket.
- (C) Loudspeaker cables in conduit:
  - (1) Ceremony Floor Downfill loudspeakers: #12 AWG, twisted-pair wire; West Penn C207 (or equal).
    - (a) Harness all lines for a neat installation, leaving a service-loop at each termination facilitating servicing loudspeakers.
    - (b) Lines in conduit may be extended to loudspeakers if sheathed in black where visible to public. Absent sheathing, provide extra-flexible portable cordage; black neoprene, rubber or PVC jacket.
  - (2) Monitor/effects loudspeaker receptacles: #12 AWG, twisted-pair wire; West Penn C207 (or equal).
  - (3) Monitor/Page System Loudspeaker Cable: #16 AWG, twisted-pair wire; West Penn C205, or West Penn 235 where three wires are required.

### 2.4.4 Video Cables

- (A) Individual composite video lines in conduit, precision video cable:  
West-Penn 819 or Belden 1505A.
- (B) RGBx lines in conduit and equipment racks, individual cables: West Penn 819 or Belden 1505A.
- (C) Local, short length (10' or less) multi-coax RGBx lines: West Penn WP8254 (or equal).

- (D) Medium length (30' or less) multi-coax RGBx lines: West Penn WP6354 (or equal).

#### 2.4.5 DC Control Cables

Provide multi-pair, stranded cable as necessary according to good engineering practice.

#### 2.4.6 Serial Data Cables

Provide stranded shield-pair cable as necessary according to good engineering practice.

#### 2.4.7 Resistors and Pads

Half-watt, 1% tolerance, composition resistors, except where otherwise shown on functional diagrams. Values may require modification, or additional resistors may be required to suit operating conditions.

### 2.5 MISCELLANEOUS EQUIPMENT

#### 2.5.1 General

- (A) Install three mic-line patch-cord holders at amplifier room and two at house mixer position. Install additional patch cord holders for video, loudspeaker, network and fiber-optic cables at amplifier room if the audio holders do not fit the other cables.

#### 2.5.2 Panels

- (A) Most panels will be matte black. The exception will be panels located around the perimeter of the ceremony floor and public spaces which will be brushed aluminum. CONFIRM LOCATIONS OF THE BRUSHED ALUMINUM PANELS WITH THE ARCHITECT BEFORE ORDERING PANELS.
- (B) Maintain a uniform appearance of panels throughout the project. Specifically, but not exclusively, use this guideline if panels are fabricated by multiple manufacturers.
- (C) Fabricate cover plates for outlet boxes, input/output boxes and AVP's from 5052-H32 or 6061-T6 aluminum sheet no less than 0.090" thick for standard "ganged" outlet boxes of three gangs or less, and not less than 0.120" elsewhere.
- (D) Grain on horizontal axis and anodize.
- (E) Finish in epoxy-based paint only if directed by, and to color approved by, Architect.
- (F) Engrave all nomenclature and graphics. If mill engraved, ink fill. If laser engraved, submit sample of text color versus background.
- (G) Contractor may submit plastic strata for approval.

#### 2.5.3 Equipment Racks

- (A) Provide internal 120 V.A.C. wiring and power outlets as required for equipment and such as not to overload branch circuits.



- (B) Provide security covers over all equipment with front panel controls intended for semi-fixed settings and not capable of software security.
- (C) Fill all unused panel spaces with blank solid or vent panels, depending on the ventilation requirements of the equipment.
- (D) Use tamper-proof rack screws: Lowell TPT832 (or equivalent).
- (E) Fixed-in-Place Equipment Racks
  - (1) Provide filtered, ventilation fan panels for each equipment rack in the Amplifier Rack Room.
  - (2) Locate racks so that equipment may be operated from the front and serviced from the rear without moving the racks (as conduits shall render them immovable).
  - (3) Wherever possible, install racks with a minimum of 36" clear in front and behind. Do not install with less than 30" in front and behind prior to seeking direction from Architect and Consultant.
  - (4) Carefully coordinate with Electrical Contractor to assure conduit entries into racks occur at appropriate locations on racks. Conduits shall not bond to racks; check that isolation bushings have been installed by the Electrical Contractor.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 General

- (A) Install equipment with all precautions necessary to prevent and guard against electromagnetic and electrostatic hum, to assure adequate ventilation, and to provide for safety of users.
- (B) Employ the latest and safest techniques throughout the installation.
- (C) Perform all work in strict conformance with the highest industry and craftsmanship standards.

The following shall serve as guidelines: current broadcast standards; current recording studio practice and techniques outlined in "Sound System Engineering" by Don and Carolyn Davis, Howard W. Sams & Co., Inc., 1987; "Sound Reinforcement Handbook" by Gary Davis and Ralph Jones, Hal Leonard Publishing Corp., 1987; Audio Systems- Design and Installation by Phillip Giddings, Focal Press, 1990; specifications contained herein.

- (D) Install all equipment neatly, plumb, square and true to line and level except as necessary for loudspeaker or microphone aiming.

- (E) At Owner's discretion, repair or reimburse Owner for damage caused by any action of Contractor's employees or resulting from the process of installation.
- (F) Provide a safety factor of at least three for all fastening and supports for fixed equipment, cabling, and components.
- (G) Install all equipment, except portable equipment, such that it is held firmly in place. This shall include loudspeakers, amplifiers, cables, et cetera (an exception to this rigid mounting clause is when it is required to use resilient shock mounting to decouple a loudspeaker from the structure it is being mounted in/on).
- (H) Use no fan-cooled equipment in equipment racks intended for use within a performance space.
- (I) Mount all permanent electronic equipment and patching facilities (if any) in electronic equipment rack cabinets (or frames, according to these documents).
- (J) Avoid damage to cables, equipment, and wiring.
- (K) Provide incidentals and accessories, compatible with other equipment, necessary to meet requirements specified herein even though not specifically called out in this specification.
- (L) Remove dirt and debris from audio system racks, panels and junction, pull and device boxes.
- (M) Seal all pre-assembled equipment racks in plastic before shipping to Project Site. Maintain plastic cover when storing racks on site prior to installation to prevent damage by materials from other trades.
- (N) Leave job site and all equipment and materials clean and free from marks, blemishes and Contractor's debris.

### 3.1.2 Audio System Isolated Technical Ground (ASITG)

- (A) Maintain isolation between ASITG and building electrical system ground except at the Building Ground Bus connection
- (B) Provide a main isolated audio ground point (MIAGP) within each bank of audio equipment racks (i.e., one rack or multiple adjacent racks). MIAGP shall consist of a copper bus bar bonded to the rack frame and of sufficient size to accommodate all secondary ground conductors. Provide a lug on MIAGP to which Electrical Contractor shall connect an insulated copper, isolated technical ground conductor having a maximum of 0.1 Ohms total resistance. The Contractor shall be responsible for confirming technical ground is properly electrically bonded to the building technical ground system. If and where aluminum lugs are used with copper wire or bus bars, anticorrosive compound shall be used.
- (C) Secondary system grounding conductors shall be provided from all racks, audio consoles, and otherwise-ungrounded audio equipment in each area, to MIAGP. Each of these grounding conductors shall have a maximum of 0.1 Ohms total resistance. Alternatively, adjacent racks may be bonded together via grounding conductors terminated at lugs

attached to abutting rack sides. Each such grounding conductor shall have a maximum of 0.01 Ohms total resistance. Care shall be exercised to assure grounding lugs make low-resistance contact with the rack.

(D) Shield Treatments

(1) Patchbays

All audio cable shields for balanced lines from or to installed equipment shall be grounded to ASITG by a single path. Tie shields to isolated ground at the receiving end (i.e., equipment inputs) only. As relates to shield terminations for lines to or from patchbays:

- (a) For wiring directly to patchbay jacks without intermediate connection points to access the patchbay jacks tie together, at the patchbay, using #12 AWG solid copper wire (or equivalent) as bus-bar material, the shield drains of lines going to the patchbay; connect this bus to MIAGP in rack via secondary grounding conductor; "float" sleeves of associated patchbay jacks. Float the shield of lines out of the patchbay and terminate the shield of each such line at the next piece of equipment downstream; bus all associated patchbay-jack sleeves together and connect this bus to MIAGP in rack via secondary grounding conductor.
- (b) For wiring patchbays having single-circuit intermediate connections for accessing the patchbay jacks, tie together, just before the intermediate connection points, using #12 AWG solid copper wire (or equivalent) as bus-bar material, the shield drains of lines going to patchbays; tie all of the intermediate connection points for input-side shields to this same bus bar; connect this bus to MIAGP in rack via secondary grounding conductor (that this, effectively, ties the shield to ground near the receiving end rather than "at" the receiving end is inconsequential); float sleeves of intermediate connecting lines at associated patchbay jacks. Float the shield of lines out of the patchbay (from the intermediate connection point) and terminate the shield of each such line at the next piece of equipment downstream; tie together the associated intermediate connection points for shields using #12 AWG solid copper wire as bus bar material and connect this bus to MIAGP in rack via secondary grounding conductor.
- (c) For wiring patchbays having multipin connectors as the intermediate connection point for accessing the patchbay jacks:

- (i) Option 1: Tie together all the ground pins from the input multipin with the shield drains at that multipin, bus to ground as described above and float the shields at the associated patchbay jacks. Bus shield drains together before the output multipin and bus to ground as described above. Assuming this approach, land shields on the ground pins of the portable (or removable) multipin connectors going to and coming from the patchbay.
    - (ii) Option 2: On the input side, provide shield throughput at the multipin connectors, bussing shield drain wires together as described for patchbays with no intermediate connection points. On the output side, treat as in Option 1, above.
  - (d) Tie the shields of balanced audio tie-lines, used for temporary interconnection, to the ground pins of panel connectors and though to jack sleeve connections at patchbays. Do not bus together the shields of these lines either to or from patchbays.
- (E) Other Shield Treatments
- (1) The shields of portable cordage, such as, microphone cables, shall be connected at both ends to cable-connector ground terminal (or pin).
  - (2) Insulate all cables from conduit and extraneous grounds. Do not tie the shell of cable-type microphone connectors to shield except within microphones themselves. Chassis connectors, which utilize their shells as conductors for shields (i.e. 1/4" phone jacks, 3.5mm mini-jacks, RCA jacks, et cetera), shall be insulated from their mounting plate.
  - (3) Maintain continuity of shields at all connecting points except as required by standard practice for 'floating' shields.
  - (4) Follow good engineering practice, as outlined above; deviate from these practices only when necessary to minimize crosstalk or to maximize signal-to-noise ratios in the audio and video systems; report deviations to the Associate Architect and Consultant prior to implementation.

### 3.1.3 Wiring and Cables

- (A) Make wiring connections with rosin-core solder or mechanical connectors. Use mechanical connectors in strict conformance with the manufacturers' specifications with regard to wire gauge, wire type (stranding), insulation type and thickness, number of conductors at a single termination, terminal-screw diameter requirements, et cetera. Restrict use of 'wire nuts' to mains power wiring where acceptable to code and

related sections. Wire nuts are not acceptable for audio connections.

- (B) Clear all raceways, racks, and junction boxes of foreign matter and substances prior to installation of wire or cable.
- (C) Make no cable or wire splices inside of conduit or raceways.
- (D) Make no splices in any microphone lines. (Termination of a microphone line at an approved mechanical connector for making parallel wiring connections, or connection to pre-wired patch panels is not considered a 'splice').
- (E) Connections to rack-mounted equipment by means of phone plugs are not acceptable if the equipment has alternate connectors.
- (F) Use heat-shrinkable tubing to dress the shield and cable jacket wherever shielded cable is stripped-back for termination. The exception to this rule is when the cable terminates within the back shell of a single-circuit cable plug (accordingly, such terminations within multi-circuit plugs do require heat-shrinkable lead dress).
- (G) Install required microphone, line-level, production communications, loudspeaker, video and control wiring in conduits provided and installed by Electrical Contractor. Coordinate conduit-fill to minimize mixing of signal types. If cables of different signal types shall be combined in conduits or raceways, the following schedule shall be used for determining acceptability of conduit fill:
  - (1) Microphone-level circuits below -30 dBu, 20 to 20,000 Hz; non-relay DC control less than 50 volts; DC power less than 30 VA into resistive loads; MATV signal less than 1000 microvolt peak-to-peak into 50 or 75 Ohms, 47 to 890 MHz.
  - (2) Line level audio, -30 dBu to +24 dBu, 20 to 20,000 Hz; baseband and composite video, 1 volt peak-to-peak into 75 Ohms, 0 to 10 MHz; color subcarrier, 0 to 4 volts peak-to-peak into 75 Ohms, 3.57 to 4.43 MHz; non-relay DC control less than 50 volts; relay DC control less than 50 volts for runs less than 20 feet.
  - (3) Loudspeaker-level circuits, greater than +24 dBu, 20 to 20,000 Hz; relay or non-relay DC control less than 50 volts; DC power less than 60 VA; synchronous control or data wiring less than 40 volts.
  - (4) Baseband and composite video, 1 volt peak-to-peak into 75 Ohms, 0 to 10 MHz; color subcarrier, 0 to 4 volts peak-to-peak into 75 Ohms, 3.57 to 4.43 MHz; video synchronization and switching pulses, 4 volts peak-to-peak into 75 Ohms; non-relay DC control less than 50 volts; DC power less than 30 VA into resistive loads.
  - (5) AC Power alone.

- (6) Additional cable combinations as approved by Consultant or specifically indicated by the specification.
- (H) Dress all cables within racks neatly and such that there is adequate service loop adjacent to terminations to allow at least one termination repair without unharnessing loom.
- (I) Install proper-fitting neoprene or nylon grommets where cables pass through holes in racks, boxes, or any other cabinetry, to prevent abrasion of the cables.
- (J) It is strongly recommended to test all cable lengths for serviceability before and during connection to equipment to determine if any faults have developed during the cable installation. Testing for open and short circuits shall be conducted on all cable after installation and before equipment and cable termination enclosures are closed.

#### 3.1.4 Labels

##### (A) General

- (1) Remove visible logos from loudspeaker systems.
- (2) Affix a single, small acknowledgment plate listing "Designed By:" and "Installed By:" to one AV equipment rack in the Amplifier Room. This plate shall list the firm name, address, and phone number of the System Consultant and AV Systems Contractor.
- (3) Apply no advertising to racks, equipment, and accessories.

##### (B) Wires and Cabling

- (1) Label each and every cable in system with machine-printed wire tags protected by clear heat shrinkable tubing or with self-laminating "write-on" labels.
- (2) Use a logically sequenced alphanumeric system, maintaining the same circuit designation from origin to destination.
- (3) Use a color scheme that is legible and easy to understand.
- (4) Attach wire tags to the cables such that they are easily read and the cable easily identified, usually about 1/2" from the cable end. Tag both ends of each cable.
- (5) No two cables shall bear the same number.
- (6) Multi-paired and multi-conductor cables shall bear a single number with number and conductor colors appearing on "As-Built" record documents.
- (7) Ground wires need not be wire tagged.

##### (C) Panels

- (1) Clearly, logically and permanently label all custom controls, jacks and receptacles.
- (2) Methods:

- (a) Engrave and fill or silk screen custom rack panels.
  - (b) Engrave and fill receptacle box plates.
  - (c) Use characters at least 1/8" high on equipment mounted in rack cabinets and at least 1/4" high elsewhere, with character stroke width at least 10% of character height, wherever possible.
- (3) Printed labels and embossed tape shall not be accepted for labeling.
- (D) Racks, rack-mounted equipment and controls
  - (1) Preferred method, see "Panels".
  - (2) Label all rack-mounted equipment items and their controls where utilized.
  - (3) Engraved plastic lamicoid labels are acceptable. See "Panels" for character heights and spacing.
    - (a) Use simple and tasteful color scheme that is legible and easy to understand.
    - (b) Use uniform type face, font size and label size.
  - (4) Printed tape may be approved for labeling of racks, rack-mounted equipment and controls under specific circumstance(s). Submit request for approval to Consultant.
  - (5) Embossed tape shall not be accepted for labeling.
  - (6) See "Panels" for character heights and spacing.

### 3.1.5 Polarity

- (A) Polarity of adjacent loudspeakers with respect to each other: a listener moving from in front of one loudspeaker to the next shall sense a single apparent sound source which shifts smoothly and continuously as he moves. At midpoint, sound source shall appear to be midway between loudspeakers.
- (B) Polarity of lines and microphones: check for uniform polarity with respect to each other, of: microphone lines; lines to loudspeaker receptacles; loudspeakers; reinforcement microphones of the same type.
- (C) Follow the "pin two is hot" standard for wiring balanced lines.

### 3.1.6 Trade Coordination

- (A) Make moderate moves or changes as necessary to accommodate other equipment or preserve symmetry and pleasing appearance without claim for extra payments.
- (B) Obtain approval from Consultant and Owner's Representative before making changes necessitated by field conditions.
- (C) Cooperate with other trades to achieve well-coordinated progress and satisfactory final results.

## 3.2 INITIAL TESTING and ADJUSTMENTS

3.2.1 Provide necessary calibrated test equipment.

3.2.2 Adjust settings or modify components as necessary to achieve System performance conforming to specification.

3.2.3 Upon completion of installation, perform the following initial tests and record results:

## (A) Absolute Impedance

- (1) Measure impedance of each loudspeaker line at Audio Equipment Rack in control room at 250 Hz, 1 kHz; 8 kHz.
- (2) With lines disconnected from their destination, measure resistance in lines to microphone, auxiliary and line inputs with receptacles open and short-circuited.

## (B) Mechanical

- (1) Verify integrity of support provisions.
- (2) Verify absence of debris of any kind, tools, et cetera

## (C) Power and Isolated Ground

- (1) Verify isolation of Audio System Isolated Technical Ground from raceway and building electrical ground.
- (2) Verify integrity of signal-ground and Audio System Isolated Technical Ground connections.
- (3) Verify proper provision of AC power to devices and equipment.

## (D) Signal Wiring and Cables

- (1) Verify absence of continuity in XLR cables between pin #1 and connector shell. Modify wiring of cables that do not conform to this standard.
- (2) Verify integrity of insulation, connections and shield terminations.
- (3) Verify integrity of soldered connections including absence of solder splatter, solder bridges and cold-solder joints.
- (4) Verify routing and dressing of wire and cable as neat and in accordance with good engineering practice. Correct installation conditions that do not meet these requirements.
- (5) Verify point-to-point continuity of all signal and control wiring and cables.
- (6) Verify conformance with wire designations on "As-Built" wiring diagrams.
- (7) Test microphones, loudspeakers and cables for proper polarity, correcting any discrepancies found.

## (E) Hum and Noise Level



- (1) Adjust mixer/switcher input gain controls for 0 dB reading with pink noise at -55 dBu level at microphone input; 0 dBu at line level input.
  - (2) Without changing gain, terminate microphone and line-level inputs with shielded resistors of 150 and 1,000 Ohms, respectively.
  - (3) Terminate power amplifier outputs with power load resistors matching nominal impedance of output terminals used in System.
  - (4) With amplifiers at full power, measure overall hum and noise level at each power amplifier output.
    - (a) Acceptable noise level: 80 dB below rated output of amplifier, minimum.
- (F) Electrical Distortion. (Only required during acceptance testing in the event of the use of non-approved equipment or evident audible electrical distortion.)
- (1) Adjust mixer/switcher input gain controls as described for "Hum and Noise Level" tests.
  - (2) Terminate power amplifier outputs as described for "Hum and Noise Level" tests.
  - (3) Apply 800 Hz sine-wave signal from oscillator having less than 0.5% total harmonic distortion to line-level input at level required to produce measured full amplifier output.
  - (4) Measure distortion with distortion analyzer or observe waveform on oscilloscope to ascertain that distortion is less than that specified.
    - (a) Total Harmonic Distortion: less than 0.20% max. from 20 Hz to 20 kHz.
- (G) Parasitic Oscillation and RF Pickup
- (1) Set up system for typical modes of operation (i.e., "Standard" and "Auto" microphones connected, auxiliary audio source connected, control system connected, et cetera)
  - (2) Use 10 MHz bandwidth oscilloscope and loudspeaker monitoring.
  - (3) Check to ensure that system is free of spurious oscillation, RF pickup in absence of input signal; also with system driven momentarily to full output at 160 Hz.
- (H) Buzzes, Rattles, and Acoustic Distortion
- (1) Apply sine-wave sweep from 50 to 16,000 Hz at 6 dB below rated power amplifier output voltage.
  - (2) Listen carefully for buzzes, rattles and objectionable distortion in loudspeaker systems and room furnishings, fixtures and finishes.

- (3) Remedy causes of objectionable electronic or loudspeaker distortion.
- (4) If within these systems remedy causes of buzzes or rattles.
- (5) If within room furnishings, fixtures or finishes, promptly notify Architect, Consultant and General Contractor indicating cause and suggesting corrective procedures.
- (6) Work with other trades to correct problems.
- (I) Overall Performance. Measure performance to verify conformity with respective performance specifications herein.
- (J) Gain Control Settings. Adjust gain controls on rack-mounted equipment for optimum signal-to-noise and signal balance. Place temporary marks on settings using small pressure-sensitive arrows (preferred) or pressure-sensitive dots with indicating line. "White-Out", masking tape and other slipshod methods are not acceptable.
- (K) Report. Upon completion of above tests and necessary adjustments, submit two copies of a written report presenting test results, including numerical values where necessary, for review by the Architect/Engineer prior to demonstration and acceptance testing.
- (L) Certification. With the above report, submit written notice that the installation conforms to the specification and other contract documents, is complete, and is ready for inspection and testing by representatives of the Owner, Architect and Consultant.

### 3.3 ACCEPTANCE TESTING and DEMONSTRATION of COMPLETED INSTALLATION

- 3.3.1 Upon approval of the above report, and at a time set by the Owner, demonstrate operation of each major component, using all input, control, amplification, and projection equipment. After demonstration, assist as required in the following acceptance tests by representatives of the Owner.
- 3.3.2 To comply with Project Schedule and to avoid conflict with work of other sections, testing procedures may be required by Consultant to be performed at any hour of day or night. With a minimum of three days notice of Acceptance Testing, provide specified personnel and equipment at any time during Acceptance Testing without claim for additional labor or other costs.
- 3.3.3 Provide services of designated supervisor and an adequate number of technicians familiar with the Work of this Section as required to comply with Project Schedule.
  - (1) Acceptance testing will include the evaluation of systems performance during a maximum of three event rehearsals, including a full dress rehearsal, and the first public event involving major use of the systems. An AV Contractor's representative familiar with the Work of this Section must be present.

## 3.3.4 Provide the following:

- (A) Computer connected to DSP programming inputs and with software installed for adjustment to the DSP program, available at the in-house mix position for system tuning.
- (B) Tools, as required for performance of adjustment and corrections to this Work.
- (C) Spare wire and connectors and specialized connector tools if applicable.
- (D) Ladders, scaffolding, lifts required to access sound system devices, connection points, junction boxes, including clusters.
- (E) Test equipment specified, used for Initial Testing and Adjustments.
- (F) A Complete set of latest stamped and actioned submittals for reference.
- (G) A Complete set of Shop Drawings and Initial Testing Reports.
- (H) Complete set of manufacturer's original operation, instruction and service manuals for each equipment item for reference.

## 3.3.5 Equipment Tests

- (A) Any measurements of frequency response, distortion, noise or other characteristics and any operational tests deemed necessary by the Consultant may be performed on any item or group of items to determine conformity with specification.
- (B) If need for adjustment becomes evident during demonstration and testing, the Contractor's work shall be continued until the installation operates properly in the opinion of the Consultant.
- (C) If final acceptance is significantly delayed because of defective new equipment or because of installation not in accordance with specification, the Contractor shall pay for all additional time and expenses of the Owner's representatives during any resultant extensions of the acceptance-testing period.

## 3.3.6 Listening Tests shall consist of subjective evaluations by observers listening at various positions under various operating conditions, using speech, music and recorded program material. The approval of the Consultant shall conclude the Listening Tests.

## 3.4 CLOSE-OUT

The scheduled project completion date shall be provided prior to making the contract. As of this date systems shall be tested and complete.

At the discretion of the Owner, Final Acceptance Testing and correction of "punch list" items may extend beyond the date for substantial completion. Contractor shall be advised as to any changes in expected date of completion.

## 3.4.1 Punch List

- (A) Perform required remedial work, without claim for additional labor or other costs. Where required, re-test and submit revised Test Report.
- (B) Notify Consultant and Owner's Representative of completion of Punch List.

## 3.4.2 Training and Instruction

- (A) Provide a minimum of three on-site training sessions to Owner in operation of system.
- (B) Provide training and instruction by personnel thoroughly familiar with equipment provided.
- (C) Allow for 16 hours (total) of actual on-site training with various user groups.
- (D) All training session shall be video taped by AV Contractor and 2 copies of all video supplied to the users.
- (E) Submit session outline, copies of "handouts" for review by Consultant five business days prior to scheduled sessions.

Instruction shall include:

- (1) Demonstration of purpose for, and operation of, each component.
- (2) Review of functional diagrams and Owner's manual.
- (3) Demonstration and explanation of operation of system controls and components including functional variations.

## 3.4.3 Warranty

- (A) Submit one-year warranty dated to begin with Acceptance of the Work of this Section.
- (B) Submit proposal for one year and three years of additional, continued warranty and maintenance service

## 3.4.4 OWNER'S RIGHT TO USE EQUIPMENT

- (A) Acceptance of the Work of this Section shall occur after completion of corrections and adjustments required by "Punch List" (as generated during Demonstration and Acceptance Testing of Completed Installation).
- (B) Owner reserves the right to use equipment, material and services provided as part of Work of this Section, prior to Acceptance, without incurring any obligation to accept any equipment or completed systems until Punch List work is complete and systems comply with specification.

## PART 4 - EQUIPMENT SCHEDULE

THE PRODUCTS LISTED BELOW ARE THE BASIS OF DESIGN FOR THIS PROJECT. ALTHOUGH SPECIFIC PRODUCTS ARE LISTED, CONTRACTORS ARE NOT PRECLUDED FROM REQUESTING THE SUBSTITUTION OF OTHER PRODUCTS AS DETAILED IN THE AV SPECIFICATION.

THE COSTS OF THE ELECTRICAL INSTALLATION OF POWER, CONDUIT AND BACK BOXES ARE NOT INCLUDED IN THIS EQUIPMENT LIST. THE COST OF ANY APPLICABLE TAX ON

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EQUIPMENT PURCHASES IS NOT INCLUDED IN THIS EQUIPMENT LIST. BIDDERS ARE TO CONFIRM ALL MODEL NUMBERS, QUANTITIES AND ACCESSORIES.

<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Qty</u>	<u>Inst.</u>
WIRED MICROPHONES AND ACCESSORIES				
Monitor/Hearing Assist/Recording Stereo Mic	Audio-Technica	AT825	1	Y
Handheld Condenser Mics (Cardioid)	Shure	SM87A	2	
Cardioid Condenser Instrument Mics	Shure	KSM109	2	
Cardioid Condenser Instrument or Vocal Mics	Shure	KSM27	2	
Dynamic Instrument Mics	Shure	Beta 57A	2	
Dynamic Vocal Mics	Shure	Beta 58 MR	2	
Dynamic Vocal Mics	Shure	SM58 LC	4	
Condenser Microphone for Vocal Booth	Shure	KSM32	1	Y
Microphone Arm and Bracket for Vocal Booth	Luxo or Equal	KM-1 w/C Black Table Bracket	1	Y
Microphone Pop Screen for Vocal Booth	Raxxess or Equal	POMT 6"	2	Y
Headphone Amplifier for Vocal Booth/Pwr Supply	Benchmark Media	IFA-7, PS-1	1	Y
Cardioid Dynamic Instrument Mic	Sennheiser	MD421-II	2	
Overhead/ General Purpose Mics	Audio-Technica	AT853Rx	3	
Short Telescoping Stands	Atlas	DMS10E	2	
Short Booms	Atlas	DMB-10XE	2	
Collapsible Tripod Base Microphone Stand/Boom	AKG	KM275BLK	4	
Standard Upright Stands	Atlas	MS-20E	4	
Standard Boom Arms	Atlas	PB21XE	2	
Lightweight Stands	Atlas	MS10 CE	2	
Very Short Floor Stands	Atlas	DMS-7E	2	
Pipe Clamp Mic Mount	Atlas	MAC-1	2	
Mid-Stand Mic Clamp	Atlas	CO-1B	2	
Cable Hook	Atlas	CH-1BE	4	
Desk Stands	Atlas	DS-7E	2	
IN-HOUSE MIX POSITION				
Main Mixer	Soundcraft	MH3-40 Tourpack	1	
DSP/Camera Control - 12" Touch Panel+Interface	Crestron	TPS-4500V	1	Y
DSP/Camera Control - Touch Panel Hatch Back Kit	Crestron	HBK-6000	1	
LOUDSPEAKERS				
Main Grandstand Loudspeakers	Renkus-Heinz	ST6/94	12	Y
Main Grandstand Loudspeaker Mounting	by Contractor	by Contractor	12	
Ceremony Floor Downfill Loudspeakers	Tannoy	V8	18	Y
Downfill Loudspeaker Yoke Mount	Tannoy	V8Y (80012700 Blk.)	18	
Downfill Loudspeaker Pole Clamp	Tannoy	VPC (80012580 Blk.)	18	
Monitor/Effects Loudspeakers	Renkus-Heinz	TRX81/9	4	
Monitor/Effects Loudspeakers	Renkus-Heinz	TRX151/9	4	
WIRELESS MICROPHONES				
UHF Dual-Channel Microphone Receiver	See Mic Splitter Rack Below			
Wideband UHF Wireless Antenna Splitter	See Mic Splitter Rack Below			

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	Microphone Transmitters UHF w/Lemo Connector	Shure	U1L Bodypack	8	
	Active Directional Antennas	Shure	UA870WB	2	Y
	25' BNC Antenna Cables	Shure	UA806	2	
	Handheld Mic/Transmitter	Shure	U2/Beta87C	8	
	Lavalier Microphones w/ Tie Clip (Black)	Sennheiser	MKE2-LEMO/Buf	5	
	Lavalier Microphones w/ Tie Clip (Lt. Flesh)	Sennheiser	MKE2-LEMO/Black	5	
AMPLIFIER RACKS					
	Equipment Rack for AV Amp Room	Middle Atlantic	ERK-4425	2	
PA1	Central-Floor Downfill Power Amplifiers	Crown	Micro-Tech 1200	4	
PA2	Monitor/Effects Power Amplifiers	Crown	Micro-Tech 1200	2	
PA3	Monitor/Effects Power Amplifiers	Crown	Micro-Tech 2400	2	
MA1	Monitor/Page - Power Amplifier	Crown	CTs 600	1	
MA2	Monitor/Page-Back Of House-Power Amplifier	TOA	P-912MK2	1	
	Input Module for MA2	Toa	B-01S	1	
MA3	Marshalling Area - Power Amplifier	TOA	P-912MK2	1	
	Input Module for MA3	Toa	B-01S	1	
	5-Port Gigabit Ethernet Router for DSP Cobranet. Must be Cobranet Approved (hidden in rack)	Linksys or equal	SD2005	1	
	8-Port Gigabit Ethernet Router for AV Network Must be Cobranet Approved. (rack-mounted)	Linksys or equal	EF3805	1	
	Wireless 802.11g Network Access Point	Linksys or equal	WAP54G	1	
	DSP 24 I/O Units	Biamp	Audia Flex CN	2	Y
	DSP Input Expander	Biamp	Audia EXPI	1	Y
	DSP Output Expander	Biamp	Audia EXPO	2	Y
	DSP Logic Box	Biamp	Logic Box	1	Y
	DSP Mic/Line Input Modules	Biamp	IP2	7	Y
	DSP Mic/Line Output Modules	Biamp	OP2	5	Y
	UPS Power for DSP	Tripp Lite or equal by APC	OmniPro500	1	Y
	Hearing Assist Single-Channel Transmitter	Telex	ST-200	1	
	Video Modulator	Blonder Tongue	FA3M	1	
	MATV - Indoor Splitters	Blonder Tongue	CRS, CRSP, CVS Series	Lot	
	MATV - Tap-off	Blonder Tongue	DCW, CRT Series	Lot	
	MATV - Terminators	Blonder Tongue	BTF-TP	Lot	
	Video Distribution Amplifiers	Extron	CVDA 6 MX Dual	1	
	Video Distribution Amplifiers	Extron	CVDA 6 MX	1	
	Rack Shelf for Extron Modules	Extron	1RU Rack Shelf	2	
	2-Channel Main Station	Telex	MS-2002	1	
	4-Channel Expansion Main Station	Telex	EMS-4001	1	
	Rack Mount Kit for Intercom Main Stations	Telex	RMK-D	1	
	Wireless Intercom Interface	Telex	BTR-700	1	
	12" XLR Cable for Wireless Intercom Patching	by Contractor	by Contractor	1	
	Monitor/Page Logic Controlled Relay	RDL	ST-LCR1	2	
	Monitor/Page Chime Module	RDL	FP-CH8	1	
note #1	Controller	Crestron	MC2E	1	Y

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note #1	Network Junction Module	Crestron	CNTBLOCK	2	
note #1	75 Watts Power Supply for Control System	Crestron	CNPWS-75	2	
note #1	Rack Mount Kit for Control System	Crestron	CNXRMAK	1	
note #1	Power Pack	Crestron	PW2420-RU		
	Power Supply for Camera	Sony	CMA-D2CE	1	
	Mic-Level Patchbay - Dbl Row, 26 Patch Point. All normals must be sleeve-normalled. Solder cups, 3-pin or Elco/EDAC only; NO PUNCHDOWNS ALLOWED.	Audio Accessories (or equal by Whirlwind, ProCo, Bittree or ADC)	TBD by AV Contractor - Submit make and model for approval by Consultant	1	Y
	Line-Level Audio Patchbays - Dbl Row, 26 Patch Pnt. Shields bussed to busbar in rack	Audio Accessories (or equal by Whirlwind, ProCo, Bittree or ADC)	TBD by AV Contractor - Submit make and model for approval by Consultant	4	Y
	Line-Level Audio Patchbays - Single Row, 26 Patch Pnt. Shields bussed to busbar in rack	Audio Accessories (or equal by Whirlwind, ProCo, Bittree or ADC)	TBD by AV Contractor - Submit make and model for approval by Consultant	1	Y
	Balanced to Unbalanced and Unbalanced to Balanced Converters	RDL	STA-1	2	
	Line-Level Splitter/Combiners	RDL	STD-10K	2	
	Mic-Level DA	RDL	STM-DA3	1	
	AV Network Patchbay; 48 port CAT6	Hubbell	Nextspeed P67048B	1	
	Network Patchcables; 18" CAT6	Hubbell	PCX6Y3	12	
	Fiber Optic Patchbay	fiber.com	F-PNL-24-STSX	1	
	ST-ST Multi-Mode Threaded Feedthroughs	fiber.com	F-FDT-STST-MMSMSX-PHO	26	
	ST Multi-Mode Fiberoptic Patchcables	fiber.com	F-JUM-STST-SMSX-CER	8	
	Loudspeaker Patch Panel	Custom	Custom	1	Y
	Power Sequencing with Power Outlets at racks and remote turn-on at Amplifier Room and Ancillary Rack at the In-House Mix Position.	Atlas/Soundolier, or equal by Middle Atlantic, Lowell or Raxxess	SACR-191 and sequenced outlets	1	
	Video Patchbay - Double Row, 26 Patch Point	Audio Accessories (or equal by ADC)	TBD by AV Contractor - Submit make and model for approval by Consultant	3	
ANCILLARY EQUIPMENT RACK					
	Rolling Rack (w/locking front & Rear panels)[27RU]. Front must close and lock with patch cables inserted. Rear must store cables.	CalZone/Anvil	Custom	1	
	Preview Video Monitor on Top of Rack	JVC	TM-A13SU	1	
	Rack Light	Littlelite	RL-10D	1	
	2-Channel Remote Station	Telex	US-2002	2	
	4-Channel Expansion Remote Station	Telex	ES-4000A	2	
	Rack Mount Kit for Remote Stations	Telex	RMK-D	2	
	AVP on Front Rack Rails for Page and Chime Select	by Contractor	by Contractor	1	

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Auto-Pause CD Player	Marantz	331	1
Video Patchbay - Double Row, 26 Patch Point	Audio Accessories (or equal by ADC)	TBD by AV Contractor - Submit make and model for approval by Consultant	1
DVD Player	Marantz	PMD930	1
DVD Recorder	Panasonic	LQ-DRM2000	1
Custom Rack-mount for Video Recorder (rack shelf with surround for front)	Raxxess or equal by Middle Atlantic, Lowell or Soundlier	by Contractor	1
2-Channel Effects Processor	TC Electronic	M1-XL	1
2-Channel Compressor/Limiter	Dbx	1066	1
1/3 Octave Dual Channel Equalizer	Ashly	GQX-3102	1
Line-Level Audio Patchbays - Double Row, 26 Patch Point, 2RU	Audio Accessories (or equal by Whirlwind, ProCo, Bittree or ADC)	TBD by AV Contractor - Submit make and model for approval by Consultant	3
Line-Level Audio Patchbays - Single Row, 26 Patch Point, 1RU	Audio Accessories (or equal by Whirlwind, ProCo, Bittree or ADC)	TBD by AV Contractor - Submit make and model for approval by Consultant	1
Balanced to Unbalanced and Unbalanced to Balanced Converters	RDL	STA-1	3
Unbalanced to Balanced Converters for DVD and Video Recorder Outputs	RDL	ST-UBA2	2
Line-Level Splitter/Combiners	RDL	STD-10K	2
3RU Rack Drawer	Middle Atlantic or equal	D3	1
1RU Vent Panels for Rack Rear	by Contractor	by Contractor	2
Blank Panels for Rack Rear	by Contractor	by Contractor	Lot
AVP on Rear Rack Rails	by Contractor	by Contractor	1
Power Panel on Rear Rack Rails	by Contractor	by Contractor	1
EQUALIZER RACK			
Rolling Rack (w/locking front & rear panels)[21RU]	CalZone/Anvil	Custom	1
Rack Light	Littlelite	RL-10D	1
2-Channel Compressor/Limiter	Dbx	1066	2
Dual 7-band Parametric Equalizer	Ashly	PQX-572	1
Dual 1/3 Octave Dual Channel Equalizer	Ashly	GQX-3102	4
1RU Vent Panels for Rack Rear	by Contractor	by Contractor	2
Blank Panels for Rack Rear	by Contractor	by Contractor	Lot
AVP on Rear Rack Rails	by Contractor	by Contractor	1
Power Panel on Rear Rack Rails	by Contractor	by Contractor	1
MIC SPLITTER RACK			
Rolling Rack (w/locking front & rear panels)[27RU]	CalZone/Anvil	Custom	1
Rack Light	Littlelite	RL-10D	1
Wideband UHF Wireless Antenna Splitter	Shure	UA845US Antenna Splitter	1



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UHF Dual-Channel Microphone Receiver	Shure	U4D Receiver	4	
Mic-Level Audio Patchbay - Dbl Row, 26 Pch Pnt, 2RU, Sleeve Normals Out. Solder cups or Elco/Edac only- NO PUNCH DOWNS ALLOWED.	Audio Accessories (or equal by Whirlwind, ProCo, Bittree or ADC)	TBD by AV Contractor - Submit make and model for approval by Consultant	4	
Mic-Level DA	RDL	STM-DA3	2	
8 Input x 3 Output Microphone Splitter	ProCo	MS83P	5	
3RU Rack Drawer	Middle Atlantic	D3	1	
1RU Vent Panels for Rack Rear	by Contractor	by Contractor	2	
Blank Panels	by Contractor	by Contractor	Lot	
AVP on Rear Rack Rails	by Contractor	by Contractor	1	
Power Panel on Rear Rack Rails	by Contractor	by Contractor	1	
PORTABLE SM RACK				
4RU Portable Rack	SKB	X-RACK4	1	
Rack Light	Littlelite	RL-10D	1	
2-Channel Remote Station	Telex	US-2002	2	
4-Channel Expansion Remote Station	Telex	ES-4000A	2	
Rack Mount Kit for Remote Stations	Telex	RMK-D	2	
AVP on Front Rack Rails for Page and Chime Select	by Contractor	by Contractor	1	
Blank Panels	by Contractor	by Contractor	Lot	
AVP on Rear Rack Rails for Page and Chime Connectors	by Contractor	by Contractor	1	
Power Panel on Rear Rack Rails	by Contractor	by Contractor	1	
MONITOR/PAGE SYSTEM				
Monitor/Page Loudspeaker	Tannoy	CMS65 ICT-15	56	
Loudspeaker Back Can (Supply to EC for Installation)	Tannoy	TEQ 660	56	Y
Tile Bridge	Tannoy	TTB 6/8 Tile Bridge	14	
Loudspeaker Grill	Tannoy	TRG 6/8 Round Grill	56	
Marshalling Area Loudspeakers	EV	PA60	2	
100W Loudspeaker Attenuators	Atlas Soundolier	AT100	1	
35W Loudspeaker Attenuators	Atlas Soundolier	AT35	3	
10W Loudspeaker Attenuators	Atlas Soundolier	AT10	8	
HEARING ASSISTANCE SYSTEM				
One-Channel Receiver (4% of seatcount)	Telex	SR-50	48	
Dual Mini Earbud Earphone	Telex	DEB-2	60	
Earbud Replacement Covers (12)	CCS-12	EAR 015-10	10	
Neckloop	Telex	NL-4S	5	
Rack-Mount Kit	Telex	RM-S	1	
1/2 Wave Dipole Gain Antenna	Telex	HGA-1	1	
2-Pocket Receiver Charger	Telex	TC2-100	10	
ADA Wall Plaque	Telex	WP-1	1	
Rechargeable Nicad Batteries	Telex	NCB-AA	108	
PRODUCTION INTERCOM SYSTEM				
Single Channel Belt Pack	Telex	BP-1002	10	
Wireless Intercom Transceiver	Telex	TR-700	2	
12" XLR Patch Cord for Wireless Intercom	by Contractor	by Contractor	1	

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Wireless Intercom Charger and Battery Packs	Telex	BC-700NM4(US)	1	
Intercom Handset	Telex	HS-6000	4	
Single Ear Closed Muff Headset	Telex	PH-1R	10	
12" Page Microphone	Telex	MCP-90-12	2	
PORTABLE EQUIPMENT				
Active Direct Boxes	Whirlwind	Hot Box	2	
Passive Direct Boxes	ProCo	DB-1	4	
Press Box Audio Distribution	Whirlwind	PressPower-II	2	
Computer Audio/Video Interface	Extron	RGB 192 Kit plus Audio Interface Cables	1	
Headphones	Sennheiser	HD280 Pro	3	
AUDIO PATCH CORDS				
Mic/Line Patch Cables	Audio Accessories (or equal by Whirlwind, ProCo or ADC)	623A	30	
Mic/Line Patch Cables	Audio Accessories (or equal by Whirlwind, ProCo or ADC)	623B	30	
Mic/Line Patch Cables	Audio Accessories (or equal by Whirlwind, ProCo or ADC)	623D	30	
Mic/Line Patch to Male XLR Adapters	Audio Accessories (or equal by Whirlwind, ProCo or ADC)	636A	4	
Mic/Line Patch to Female XLR Adapters	Audio Accessories (or equal by Whirlwind, ProCo or ADC)	646D	4	
Loudspeaker patch cables	ProCo	S144NN-3/Custom Wired	12	
Patch Cord Holder	Audio Accessories	PCH-X	4	Y
Patch Cord Holder	Audio Accessories	VPCH-X	2	Y
AUDIO CABLES AND ADAPTERS				
Microphone Cables	Whirlwind/ProCo	10ft	20	
Microphone Cables	Whirlwind/ProCo	25ft	20	
Microphone Cables	Whirlwind/ProCo	50ft	12	
XLR Adapter	Neutrik	NA3FF/W	6	
XLR Adapter	Neutrik	NA3MM/W	6	
XLR-TRS Adapter	Neutrik	NA3FP/W	4	
XLR-TRS Adapter	Neutrik	NA3MP/W	4	
XLR-RCA Adapter	Neutrik	NA2FPMM/W	4	
XLR-RCA Adapter	Neutrik	NA2MPMM/W	4	
Portable Loudspeaker Cables	Neutrik Speakon/Pro-Co 12AWG	25ft	8	
Portable Loudspeaker Extenders	Neutrik	NL4MMX	4	
Portable Loudspeaker Cables	Neutrik Speakon/Pro-Co 12AWG	50ft	4	
AV INFRASTRUCTURE				
AVPs (Black or Brushed Aluminum by Area)	Custom	Custom	Lot	Y

## Renovations to Conmy Hall

Fort Myer, Virginia  
21 June 2004

JBs (Black or Brushed Aluminum by Area)	Custom	Custom	Lot	Y
Floor Boxes (Supply to EC for Installation). Each Floor Box has 2 Backboxes with Panel in the Middle	Ace Backstage	104BBX	4	Y
Multiconductor from EQ Rack to Monitor Mixer	Whirlwind	15'	2	
Multiconductor from Mixer to Ancillary Rack	Whirlwind	15'	1	
Multiconductor from Mixer to Splitter Rack	Whirlwind	15'	1	
Multiconductor from Panels to Stage Boxes	Whirlwind	25'	2	
Multiconductor Breakout for Broadcast or Monitor Mixer	Whirlwind	50'	1	
Miscellaneous Multiconductor Connectors	Whirlwind and Wireworks		Lot	
Video Multiconductor from Floor Box to Ancillary Rack	Wireworks	10'	1	
AV Power Panel	Custom	Custom	1	
Mic/Line Cable in Conduit	West Penn (or equal by Belden)	DA2401	Lot	Y
Unjacketed Ldspkr Cable in Conduit - Main Downfill, Mon/Effects Loudspeakers	West Penn (or equal by Belden)	C207	Lot	Y
Jacketed 3-Cond. Ldspkr Cable in Conduit - Monitor/Page System	West Penn (or equal by Belden)	235	Lot	Y
Data Cable in Conduit, CAT6 Rated	Belden or equal	1872A	Lot	
Video Cable in Conduit	Belden (or equal by West Penn)	1505A	Lot	
Multi-Mode Fiber Optic Cable in Conduit	Belden	I100255/455/655, ect	Lot	
Isolated Ground AC Power Strip	by Contractor	by Contractor	Lot	
Miscellaneous Hardware	Various	Various	Lot	
Miscellaneous Cabling, Connectors and Terminating Accessories	Various	Various	Lot	
VIDEO EQUIPMENT (Not In Amplifier Rack)				
Video Patch Cables	Audio Accessories or equal by ADC)	VPC-24	15	
Video Patch Cables	Audio Accessories or equal by ADC)	VPBN-24	5	
Video Monitors (Offices)	Panasonic	CT2089VYD	4	
Video Monitor Mounts	Middle Atlantic or equal	by Contractor	4	
Video Monitors (Lobby and VIP Lounge)	Sharp	LC-20S1U-S	5	
Video Monitor Mounts (Lobby and VIP Lounge)	Sharp	AN-PSMARM	5	
Video Camera	Sony	DXC990	1	
Camera Lens	Canon	YH18X67KTSA	1	
note #1 Pan/Tilt/Zoom/Focus Device for Camera	Crestron	CPC-CAMI	1	
note #1 Camera Lens Controller	Crestron	CNXFZ	1	
note #1 Serial Interface Cable	Crestron	CNSP-XX	1	
RGBHV Video Cables	Extron or equal	BNC-5-12'	1	
BNC Video Cables	Belden or West	10'	5	

BNC Video Cables

Penn  
Belden or West  
Penn 25'

5

END OF BASE BID

Note    Crestron quotes #18887 and #18888  
#1

SECTION 12490A

WINDOW TREATMENT  
**12/03**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701 (1999) Fire Tests for Flame Propagation of  
Textiles and Films

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G, AE

Drawings showing fabrication and installation details. Drawings shall show layout and locations of track, direction of draw, mounting heights, and details.

SD-03 Product Data

Window Treatments; G, AE  
Hardware; G, AE

Manufacturer's data composed of catalog cuts, brochures, product information, and maintenance instructions.

SD-04 Samples

Window Treatments; G, AE

Three samples of each type and color of window treatment. Blind slats or louvers shall be 6 inches in length for each color. Track shall be 6 inches in length. Shade material shall be minimum 6 x 6 inches in size.

### 1.3 GENERAL REQUIREMENTS

Window treatment shall be provided, complete with necessary brackets, fittings, and hardware. Each window treatment type shall be a complete unit provided in accordance with paragraph WINDOW TREATMENT PLACEMENT SCHEDULE. Equipment shall be mounted and operated as indicated. Windows to receive a treatment shall be completely covered. The Contractor shall take measurements at the building and shall be responsible for the proper fitting and hanging of the equipment.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants and shall have easy access for inspection and handling. Materials shall be stored flat in a clean dry area with temperature maintained above 50 degrees F.

### 1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

### 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 WINDOW SHADES

Roller tube shall operate smoothly and be of sufficient diameter and thickness to prevent excessive deflection. Brackets shall be provided that are appropriate for inside mount. The shade cloth shall meet the performance described in NFPA 701, small scale test. Steel features shall be treated for corrosion resistance.

#### 2.1.1 Light Filtering Shades

Light filtering shades shall conform to the following: Roller tube shall be extruded aluminum and shall operate by clutch and bead operation mechanism. Bead chain shall be stainless steel and shall be fully engaged in the one-piece injection molded Delrin sprocket.. Fascia mounting brackets shall be steel to support roller tube and fascia panel. The fascia panel shall be channel shaped extruded aluminum with standard enamel finish. The shade shall be made from a single piece of vinyl-coated polyester. Shade material shall be fully replaceable on site without removing drive, idle-end brackets, or tube, and shall be held into roller tube by means of a spline assembly fitting into a raceway into the tube..

## 2.2 COLOR

Color shall be in accordance with Section 09915 COLOR SCHEDULE .

## PART 3 EXECUTION

### 3.1 WINDOW TREATMENT PLACEMENT SCHEDULE

Window covering shall be provided as indicated on drawings.

### 3.2 INSTALLATION

Installation shall be in accordance with the approved detail drawings and manufacturer's installation instructions. Units shall be level, plumb, secure, and at proper height and location relative to window units. The Contractor shall furnish and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Installation shall not be initiated until completion of room painting and finishing operations. Upon completion of the installation, window treatments shall be adjusted for form and appearance, shall be in proper operating condition, and shall be free from damage or blemishes. Damaged units shall be repaired or replaced by the Contractor as directed by the Contracting Officer.

-- End of Section --

## SECTION 13080

SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT  
09/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASME INTERNATIONAL (ASME)

- |              |  |
|--------------|--|
| ASME B18.2.1 | (1996) Square and Hex Bolts and Screws,<br>Inch Series |
| ASME B18.2.2 | (1987; R 1999) Square and Hex Nuts                     |

## ASTM INTERNATIONAL (ASTM)

- |                   |  |
|-------------------|--|
| ASTM A 153/A 153M | (2003) Zinc Coating (Hot-Dip) on Iron and<br>Steel Hardware                                      |
| ASTM A 307        | (2002) Carbon Steel Bolts and Studs, 60<br>000 PSI Tensile Strength                              |
| ASTM A 325        | (2002) Structural Bolts, Steel, Heat<br>Treated, 120/105 ksi Minimum Tensile<br>Strength         |
| ASTM A 36/A 36M   | (2003a) Carbon Structural Steel  |
| ASTM A 500        | (2003) Cold-Formed Welded and Seamless<br>Carbon Steel Structural Tubing in Rounds<br>and Shapes |
| ASTM A 53/A 53M   | (2002) Pipe, Steel, Black and Hot-Dipped,<br>Zinc-Coated, Welded and Seamless                    |
| ASTM A 563M       | (2001) Carbon and Alloy Steel Nuts (Metric)  |
| ASTM A 572/A 572M | (2003a) High-Strength Low-Alloy<br>Columbium-Vanadium Structural Steel                           |
| ASTM A 603        | (1998; R 2003) Zinc-Coated Steel<br>Structural Wire Rope   |
| ASTM A 653/A 653M | (2003) Steel Sheet, Zinc-Coated  |



(Galvanized) or Zinc-Iron Alloy-Coated  
(Galvannealed) by the Hot-Dip Process

ASTM E 488

(1996; R 2003) Strength of Anchors in  
Concrete and Masonry Elements

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04

(1998) Seismic Design for Buildings

## 1.2 SYSTEM DESCRIPTION

### 1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems outlined in Section 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, the electrical equipment and systems outlined in Section 16070A SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT, and the miscellaneous equipment and systems listed below. Seismic protection requirements shall be in accordance with TI 809-04 and additional data furnished by the Contracting Officer, and shall be provided in addition to any other requirements called for in other sections of these specifications. The design for seismic protection shall be based on a Seismic Use Group II building occupancy and on site response coefficients for  $S_{MS} = [ ]$  and  $S_{M1} = [ ]$ . Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. The basic force formulas, for Ground Motions A and B in Chapter 3 of TI 809-04, use the design spectral response acceleration parameters for the performance objective of the building, not for equipment in the building; therefore, corresponding adjustments to the formulas shall be required.

### 1.2.2 Miscellaneous Equipment and Systems

The bracing for the following miscellaneous equipment and systems shall be developed by the Contractor in accordance with the requirements of this specification:

Horizontal Fan Coil Units  
Exhaust Fans  
Expansion Tanks, Heating and Chilled Water Systems  
Air Separators, Heating and Chilled Water Systems  
Stem Suspended Light Fixtures  
Sound Systems

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Bracing; G, A/E  
Resilient Vibration Isolation Devices; G, A/E  
Equipment Requirements; G, A/E

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. For equipment and systems in buildings that have a performance objective higher than life-safety, the drawings shall be stamped by the registered engineer who stamps the calculations required above.

## SD-03 Product Data

Bracing; G, A/E  
Equipment Requirements; G, A/E

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

## 1.4 EQUIPMENT REQUIREMENTS

## 1.4.1 Rigidly Mounted Equipment

The following specific items of equipment: Expansion Tanks, Heating and Chilled Water Systems, Air Separators, Heating and Chilled Water Systems, and Air Handling Ducts are to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in TI 809-04, Chapter 10. For any rigid equipment which is rigidly attached on both sides of a building expansion joint, flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions, shall be provided.

## 1.4.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished: Horizontal Fan Coil Units, Exhaust Fans, Stem Suspended Light Fixtures, and Sound Systems shall be constructed and assembled to resist a horizontal lateral force of 2 times the operating weight of the equipment at the vertical center of gravity of the equipment.

## PART 2 PRODUCTS

## 2.1 BOLTS AND NUTS

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A 307 for bolts and ASTM A 563 for nuts. Bolts and nuts

used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153/A 153M.

## 2.2 SWAY BRACING

Material used for members listed in this section, shall be structural steel conforming with the following:

- a. Plates, rods, and rolled shapes. The Contractor shall use both ASTM A 36/A 36M and ASTM A 572/A 572M, grade 503 will be allowed.
- b. Wire rope, ASTM A 603.
- c. Tubes, ASTM A 500, Grade B.
- d. Pipes, ASTM A 53/A 53M, Type S, Grade B.
- e. Light gauge angles, less than 1/4 inch thickness, ASTM A 653/A 653M.

## PART 3 EXECUTION

### 3.1 BRACING

Bracing shall conform to the arrangements shown on shop drawings. Trapeze-type hanger shall be secured with not less than two 1/2 inch bolts.

### 3.2 BUILDING DRIFT

Sway braces for a piping run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided.

### 3.3 ANCHOR BOLTS

#### 3.3.1 Cast-In-Place

Floor or pad mounted equipment shall use cast-in-place anchor bolts, except as specified below. Two nuts shall be provided on each bolt. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

#### 3.3.2 Expansion or Chemically Bonded Anchors

Expansion or chemically bonded anchors shall not be used unless test data in accordance with ASTM E 488 has been provided to verify the adequacy of the specific anchor and application. Expansion or chemically bonded anchors shall not be used to resist pull-out in overhead and wall installations if the adhesive is manufactured with temperature sensitive epoxies and the location is accessible to a building fire. Expansion and chemically bonded anchors shall be installed in accordance with the

manufacturer's recommendations. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

#### 3.3.2.1 General Testing

Expansion and chemically bonded anchors shall be tested in place after installation. The tests shall occur not more than 24 hours after installation of the anchor and shall be conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

#### 3.3.2.2 Torque Wrench Testing

Torque wrench testing shall be done on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Torque wrenches shall be calibrated at the beginning of each day the torque tests are performed. Torque wrenches shall be recalibrated for each bolt diameter whenever tests are run on bolts of various diameters. The applied torque shall be between 20 and 100 percent of wrench capacity. The test torque shall be reached within one half turn of the nut, except for 3/8 inch sleeve anchors which shall reach their torque by one quarter turn of the nut. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

#### 3.3.2.3 Pullout Testing

Expansion and chemically bonded anchors shall be tested by applying a pullout load using a hydraulic ram attached to the anchor bolt. At least 5 percent of the anchors, but not less than 3 per day shall be tested. The load shall be applied to the anchor without removing the nut; when that is not possible, the nut shall be removed and a threaded coupler shall be installed of the same tightness as the original nut. The test setup shall be checked to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus shall be at least 1.5 times the embedment length away from the bolt being tested. Each tested anchor shall be loaded to 1 times the design tension value for the anchor. The anchor shall have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested shall be tested until 20, or the balance of the consecutive anchors pass. Failed anchors shall be retightened and retested to the specified load; if the anchor still fails the test it shall be replaced.

### 3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS, except that an

equipment weight equal to five times the actual equipment weight shall be used.

#### 3.4.1 Resilient and Spring-Type Vibration Devices

Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.

#### 3.4.2 Multidirectional Seismic Snubbers

Multidirectional seismic snubbers employing elastomeric pads shall be installed on floor- or slab-mounted equipment. These snubbers shall provide 0.25 inches free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

### 3.5 SWAY BRACES FOR PIPING

Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those shown on the drawings. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400A PLUMBING, GENERAL PURPOSE. Bracing shall consist of at least one vertical angle 2 x 2 inches x 16 gauge and one diagonal angle of the same size.

#### 3.5.1 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided in accordance with Section 15070A SEISMIC CONTROL FOR MECHANICAL EQUIPMENT.

#### 3.5.2 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

#### 3.5.3 Maximum Length for Anchor Braces

Type	Size (Inches)	Maximum Length* (Feet/Inches)
Angles	1-1/2 x 1-1/2 x 1/4	4-10
	2 x 2 x 1/4	6-6
	2-1/2 x 1-1/2 x 1/4	8-0
	3 x 2-1/2 x 1/4	8-10
	3 x 3 x 1/4	9-10
Rods	3/4	3-1

Type	Size (Inches)	Maximum Length* (Feet/Inches)
	7/8	3-8
Flat Bars	1-1/2 x 1/4	1-2
	2 x 1/4	1-2
	2 x 3/8	1-9
Pipes (40S)	1	7-0
	1-1/4	9-0
	1-1/2	10-4
	2	13-1

#### 3.5.4 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

### 3.6 EQUIPMENT SWAY BRACING

#### 3.6.1 Suspended Equipment and Light Fixtures

Equipment sway bracing shall be provided for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown in the shop drawings and secured at both ends with not less than 1/2 inch bolts. Sufficient braces shall be provided for equipment to resist a horizontal force as specified in Chapter 10 of TI 809-04 without exceeding safe working stress of bracing components. The Contractor shall provide, for approval, specific force calculations in accordance with Chapter 10 of TI 809-04 for the equipment in the project. Details of equipment bracing shall be submitted for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

#### 3.6.2 Floor or Pad Mounted Equipment

##### 3.6.2.1 Shear Resistance

Floor mounted equipment shall be bolted to the floor. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

##### 3.6.2.2 Overturning Resistance

The ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads shall be used to determine if overturning forces need to be considered in the sizing of anchor bolts. Calculations

shall be provided to verify the adequacy of the anchor bolts for combined shear and overturning.

### 3.7 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452A SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --

## SECTION 13280A

ASBESTOS ABATEMENT  
11/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z87.1	(2003) Practice for Occupational and Educational Eye and Face Protection
ANSI Z88.2	(1992) Respiratory Protection
ANSI Z9.2	(2001) Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems

## ASTM INTERNATIONAL (ASTM)

ASTM C 732	(2001) Aging Effects of Artificial Weathering on Latex Sealants
ASTM D 1331	(1989; R 2001) Surface and Interfacial Tension of Solutions of Surface-Active Agents
ASTM D 2794	(1993; R 1999e1) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 4397	(2002) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 522	(1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM E 119	(2000a) Fire Tests of Building Construction and Materials
ASTM E 1368	(2002) Visual Inspection of Asbestos Abatement Projects
ASTM E 736	(2000) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to



Structural Members

ASTM E 84 (2003) Surface Burning Characteristics of Building Materials

ASTM E 96 (2000e1) Water Vapor Transmission of Materials

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-7 (2003) Compressed Air for Human Respiration

CGA G-7.1 (1997) Commodity Specification for Air

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701 (1999) Fire Tests for Flame Propagation of Textiles and Films

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 84-100 (1984; 3rd Ed, R: 1994) NIOSH Manual of Analytical Methods

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (1996) Safety and Health Requirements Manual

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 340/1-90/018 (1990) Asbestos/NESHAP Regulated Asbestos Containing Materials Guidance

EPA 340/1-90/019 (1990) Asbestos/NESHAP Adequately Wet Guidance

EPA 560/5-85-024 (1985) Guidance for Controlling Asbestos-Containing Materials in Buildings (Purple Book)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1926 Safety and Health Regulations for Construction

40 CFR 61 National Emission Standards for Hazardous Air Pollutants

40 CFR 763 Asbestos

42 CFR 84 Approval of Respiratory Protective Devices

49 CFR 107	Hazardous Materials Program Procedures
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings

## UNDERWRITERS LABORATORIES (UL)

UL 586	(1996; Rev thru Apr 2000) High-Efficiency, Particulate, Air Filter Units
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## STATE OF VIRGINIA ADMINISTRATIVE CODE (VAC)

16 VAC 25-20-30	Notification and Permit Fee
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## 1.2 DEFINITIONS

- a. Adequately Wet: A term defined in 40 CFR 61, Subpart M, and EPA 340/1-90/019 meaning to sufficiently mix or penetrate with liquid to prevent the release of particulate. If visible emissions are observed coming from asbestos-containing material (ACM), then that material has not been adequately wetted. However, the absence of visible emissions is not sufficient evidence of being adequately wetted.
- b. Aggressive Method: Removal or disturbance of building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact asbestos-containing material (ACM).
- c. Amended Water: Water containing a wetting agent or surfactant with a surface tension of at least 29 dynes per square centimeter when tested in accordance with ASTM D 1331.
- d. Asbestos: Asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.
- e. Asbestos-Containing Material (ACM): Any materials containing more than one percent asbestos.
- f. Asbestos Fiber: A particulate form of asbestos, 5 micrometers or longer, with a length-to-width ratio of at least 3 to 1.
- g. Authorized Person: Any person authorized by the Contractor and required by work duties to be present in the regulated areas.

- h. Building Inspector: Individual who inspects buildings for asbestos and has EPA Model Accreditation Plan (MAP) "Building Inspector" training; accreditation required by 40 CFR 763, Subpart E, Appendix C.
- i. Certified Industrial Hygienist (CIH): An Industrial Hygienist certified in the practice of industrial hygiene by the American Board of Industrial Hygiene.
- j. Class I Asbestos Work: Activities defined by OSHA involving the removal of thermal system insulation (TSI) and surfacing ACM.
- k. Class II Asbestos Work: Activities defined by OSHA involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos - containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic. Certain "incidental" roofing materials such as mastic, flashing and cements when they are still intact are excluded from Class II asbestos work. Removal of small amounts of these materials which would fit into a glovebag may be classified as a Class III job.
- l. Class III Asbestos Work: Activities defined by OSHA that involve repair and maintenance operations, where ACM, including TSI and surfacing ACM, is likely to be disturbed. Operations may include drilling, abrading, cutting a hole, cable pulling, crawling through tunnels or attics and spaces above the ceiling, where asbestos is actively disturbed or asbestos-containing debris is actively disturbed.
- m. Class IV Asbestos Work: Maintenance and custodial construction activities during which employees contact but do not disturb ACM and activities to clean-up dust, waste and debris resulting from Class I, II, and III activities. This may include dusting surfaces where ACM waste and debris and accompanying dust exists and cleaning up loose ACM debris from TSI or surfacing ACM following construction.
- n. Clean room: An uncontaminated room having facilities for the storage of employees' street clothing and uncontaminated materials and equipment.
- o. Competent Person: In addition to the definition in 29 CFR 1926, Section .32(f), a person who is capable of identifying existing asbestos hazards as defined in 29 CFR 1926, Section .1101, selecting the appropriate control strategy, has the authority to take prompt corrective measures to eliminate them and has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training; accreditation required by 40 CFR 763, Subpart E, Appendix C.
- p. Contractor/Supervisor: Individual who supervises asbestos abatement work and has EPA Model Accreditation Plan "Contractor/Supervisor" training; accreditation required by 40 CFR

## 763, Subpart E, Appendix C.

- q. Critical Barrier: One or more layers of plastic sealed over all openings into a regulated area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a regulated area from migrating to an adjacent area.
- r. Decontamination Area: An enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.
- s. Demolition: The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.
- t. Disposal Bag: A 6 mil thick, leak-tight plastic bag, pre-labeled in accordance with 29 CFR 1926, Section .1101, used for transporting asbestos waste from containment to disposal site.
- u. Disturbance: Activities that disrupt the matrix of ACM, crumble or pulverize ACM, or generate visible debris from ACM. Disturbance includes cutting away small amounts of ACM, no greater than the amount which can be contained in 1 standard sized glovebag or waste bag, not larger than 60 inches in length and width in order to access a building component.
- v. Equipment Room or Area: An area adjacent to the regulated area used for the decontamination of employees and their equipment.
- w. Employee Exposure: That exposure to airborne asbestos that would occur if the employee were not using respiratory protective equipment.
- x. Fiber: A fibrous particulate, 5 micrometers or longer, with a length to width ratio of at least 3 to 1.
- y. Friable ACM: A term defined in 40 CFR 61, Subpart M and EPA 340/1-90/018 meaning any material which contains more than 1 percent asbestos, as determined using the method specified in 40 CFR 763, Subpart E, Appendix A, Section 1, Polarized Light Microscopy (PLM), that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure. If the asbestos content is less than 10 percent, as determined by a method other than point counting by PLM, the asbestos content is verified by point counting using PLM.
- z. Glovebag: Not more than a 60 by 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which material and tools may be handled.
- aa. High-Efficiency Particulate Air (HEPA) Filter: A filter capable of trapping and retaining at least 99.97 percent of all

mono-dispersed particles of 0.3 micrometers in diameter.

- bb. Homogeneous Area: An area of surfacing material or thermal system insulation that is uniform in color and texture.
- cc. Industrial Hygienist: A professional qualified by education, training, and experience to anticipate, recognize, evaluate, and develop controls for occupational health hazards.
- dd. Intact: ACM which has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix. Removal of "intact" asphaltic, resinous, cementitious products does not render the ACM non-intact simply by being separated into smaller pieces.
- ee. Model Accreditation Plan (MAP): USEPA training accreditation requirements for persons who work with asbestos as specified in 40 CFR 763, Subpart E, Appendix C.
- ff. Modification: A changed or altered procedure, material or component of a control system, which replaces a procedure, material or component of a required system.
- gg. Negative Exposure Assessment: A demonstration by the Contractor to show that employee exposure during an operation is expected to be consistently below the OSHA Permissible Exposure Limits (PELs).
- hh. NESHAP: National Emission Standards for Hazardous Air Pollutants. The USEPA NESHAP regulation for asbestos is at 40 CFR 61, Subpart M.
- ii. Nonfriable ACM: A NESHAP term defined in 40 CFR 61, Subpart M and EPA 340/1-90/018 meaning any material containing more than 1 percent asbestos, as determined using the method specified in 40 CFR 763, Subpart E, Appendix A, Section 1, Polarized Light Microscopy, that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure.
- jj. Nonfriable ACM (Category I): A NESHAP term defined in 40 CFR 61, Subpart E and EPA 340/1-90/018 meaning asbestos-containing packings, gaskets, resilient floor covering, and asphalt roofing products containing more than 1 percent asbestos as determined using the method specified in 40 CFR 763, Subpart F, Appendix A, Section 1, Polarized Light Microscopy.
- kk. Nonfriable ACM (Category II): A NESHAP term defined in 40 CFR 61, Subpart E and EPA 340/1-90/018 meaning any material, excluding Category I nonfriable ACM, containing more than 1 percent asbestos, as determined using the methods specified in 40 CFR 763, Subpart F, Appendix A, Section 1, Polarized Light Microscopy, that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
- ll. Permissible Exposure Limits (PELs):

(1) PEL-Time weighted average(TWA): Concentration of asbestos not in excess of 0.1 fibers per cubic centimeter of air (f/cc) as an 8 hour time weighted average (TWA), as determined by the method prescribed in 29 CFR 1926, Section .1101, Appendix A, or the current version of NIOSH 84-100 analytical method 7400.

(2) PEL-Excursion Limit: An airborne concentration of asbestos not in excess of 1.0 f/cc of air as averaged over a sampling period of 30 minutes as determined by the method prescribed in 29 CFR 1926, Section .1101, Appendix A, or the current version of NIOSH 84-100 analytical method 7400.

mm. Regulated Area: An OSHA term defined in 29 CFR 1926, Section .1101 meaning an area established by the Contractor to demarcate areas where Class I, II, and III asbestos work is conducted; also any adjoining area where debris and waste from such asbestos work accumulate; and an area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed, the permissible exposure limit.

nn. Removal: All operations where ACM is taken out or stripped from structures or substrates, and includes demolition operations.

oo. Repair: Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM attached to structures or substrates. If the amount of asbestos so "disturbed" cannot be contained in 1 standard glovebag or waste bag, Class I precautions are required.

pp. Spills/Emergency Cleanups: Cleanup of sizable amounts of asbestos waste and debris which has occurred, for example, when water damage occurs in a building, and sizable amounts of ACM are dislodged. A Competent Person evaluates the site and ACM to be handled, and based on the type, condition and extent of the dislodged material, classifies the cleanup as Class I, II, or III. Only if the material was intact and the cleanup involves mere contact of ACM, rather than disturbance, could there be a Class IV classification.

qq. Surfacing ACM: Asbestos-containing material which contains more than 1% asbestos and is sprayed-on, troweled-on, or otherwise applied to surfaces, such as acoustical plaster on ceilings and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes.

rr. Thermal system insulation (TSI) ACM: ACM which contains more than 1% asbestos and is applied to pipes, fittings, boilers, breeching, tanks, ducts, or other interior structural components to prevent heat loss or gain or water condensation.

ss. Transite: A generic name for asbestos cement wallboard and pipe.

tt. Worker: Individual (not designated as the Competent Person or a supervisor) who performs asbestos work and has completed asbestos worker training required by 29 CFR 1926, Section .1101, to include EPA Model Accreditation Plan (MAP) "Worker" training; accreditation required by 40 CFR 763, Subpart E, Appendix C, if required by the OSHA Class of work to be performed or by the state where the work is to be performed.

### 1.3 DESCRIPTION OF WORK

#### ASBESTOS CONTAINING MATERIAL (ACM) TABLE

The asbestos abatement work includes the demolition and removal of the following asbestos containing materials (ACM's):

- 1) Material: Thermal hard pipe fitting insulation  
Location: EO Office Hall, Shower Room, Men's & Women's Lavatories  
North and South, Annex Shower, Annex Lavatory  
Approx. Quantity: 215 LF  
% Asbestos: 10-41% Chrysotile  
Condition: Fair
- 2) Material: 12"x12" White w/brown specks floor tile  
Location: Seating Area - East Side  
Approx. Quantity: 1560 SF  
% Asbestos: 2% Chrysotile  
Condition: Fair
- 3) Material: 12"x12" Floor tile mastic  
Location: Annex Hall, Sound Technician Office, Seating Area-  
East Side, Voice Booth/Control Room  
Approx. Quantity: 2330 SF  
% Asbestos: 3-5% Chrysotile  
Condition: Fair
- 4) Material: 12"x12" White w/gray specks floor tile (1)  
Location: Annex Hall, Sound Technican Office, Seating Area-East Side,  
Voice Booth/Control Room  
Approx. Quantity: 760 SF  
% Asbestos: Assumed  
Condition: Fair
- 5) Material: 12"x12" White w/dark blue dots floor tile (Replacement tile)(1)  
Location: Seating Area - East Side  
Approx. Quantity: 10 SF  
% Asbestos: Assumed  
Condition: Fair
- 6) Material: Gray exterior window/door caulking  
Location: Building Exterior  
Approx. Quantity: 1505 LF  
% Asbestos: 2% Chrysotile  
Condition: Fair
- 7) Material: White vinyl vibration damper

Location: Performance Floor, Seating Area-East Side  
Approx. Quantity: 15 ea  
% Asbestos: Assumed  
Condition: Fair

8) Material: Black vinyl vibration damper

Location: Storage Room #1  
Approx. Quantity: 1 ea  
% Asbestos: Assumed  
Condition: Fair

9) Material: Black AHU fan belt

Assumed: Seating Area-South Side, Seating Area-North Side  
Approx. Quantity: 4 ea  
% Asbestos: Assumed  
Condition: Good

10) Material: Roof drains

Location: Above performance floor  
Approx. Quantity: 14 ea  
% Asbestos: Assumed  
Condition: Fair

11) Material: Metal fire doors

Location: Sound Technician Office  
Approx. Quantity: 12 ea  
% Asbestos: Assumed  
Condition: Good

12) Material: Gray metal sheet panels

Location: Building Exterior  
Approx. Quantity: 1115 SF  
% Asbestos: Assumed  
Condition: Good

LF = Linear feet; SF = Square feet, ea = each

\*The actual total quantities present of these ACM's may be greater than those observed during the survey period due to limited access and/or obstructed views above ceiling plenum areas, behind walls, etc.

1-This floor tile type was determined not to be ACM through PLM analysis. Since the 12"x12" vinyl floor tiles are attached to the floor tile mastic below, which has been proven to be ACM, and must be removed in order to remove the floor tile mastic, they are thus assumed to be ACM and should be handled and removed according to all applicable federal, state and local regulations.

Areas behind wall surfaces and above some ceiling plenum areas were inaccessible and could not be visually surveyed for ACM. ACM including, but not limited to, thermal pipe insulation and thermal pipe fitting insulation may exist in those locations. Quantities of ACM's may be discovered during renovation/demolition activities.



THE CONTRACTOR MUST UNDERSTAND THAT IF SUSPECT ASBESTOS CONTAINING MATERIALS (ACM'S) ARE IDENTIFIED DURING RENOVATION/DEMOLITION ACTIVITIES, THE SUSPECT ACM'S MUST BE TESTED FOR ACM PRIOR TO REMOVAL AND DISPOSAL. SUSPECT ACM DETERMINED TO BE ACM MUST FIRST BE SURVEYED BY THE OWNER OR THE OWNER'S FIELD REPRESENTATIVE AND MAY RESULT IN A CHANGE ORDER TO THE SCOPE OF WORK FOR THIS PROJECT. THE CONTRACTOR FURTHER UNDERSTANDS THAT ASBESTOS CONTAINING MATERIALS (ACM'S) IDENTIFIED THROUGH RENOVATION/DEMOLITION ACTIVITIES AND PROPER ANALYTICAL TESTING MUST BE REMOVED AND DISPOSED OF ACCORDING TO ALL APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS. FURTHERMORE, THE CONTRACTOR MUST ADHERE TO THE REQUIREMENTS AND CONDITIONS SET FORTH IN THIS SPECIFICATION.

The work covered by this section includes the removal of asbestos-containing materials (ACM) which are encountered during demolition and/or renovation activities associated with this project and describes procedures and equipment required to protect workers and occupants of the regulated area from contact with airborne asbestos fibers and ACM dust and debris. Activities include OSHA Class I and Class II work operations involving ACM. The work also includes containment, storage, transportation and disposal of the generated ACM wastes. More specific operational procedures shall be detailed in the required Accident Prevention Plan and its subcomponents, the Asbestos Hazard Abatement Plan and Activity Hazard Analyses required in paragraph SAFETY AND HEALTH PROGRAM AND PLANS.

Reference the hazardous materials survey report for further information.

#### 1.3.1 Abatement Work Tasks

The specific ACM to be abated is identified on the detailed plans and project drawings. A summary of work task data elements for each individual ACM abatement work task to include the appropriate RESPONSE ACTION DETAIL SHEET (item to be abated and methods to be used) and SET-UP DETAIL SHEETS (containment techniques to include safety precautions and methods) is included in Table 1, "Individual Work Task Data Elements" at the end of this section.

#### 1.3.2 Unexpected Discovery of Asbestos

For any previously untested building components suspected to contain asbestos and located in areas impacted by the work, the Contractor shall notify the Contracting Officer (CO) who will have the option of ordering a sufficient number of bulk samples to be obtained at the Contractor's expense and delivered to a laboratory accredited under the National Institute of Standards and Technology (NIST) "National Voluntary Laboratory Accreditation Program (NVLAP)" and analyzed by PLM at no additional cost to the Government. Any additional components identified as ACM that have been approved by the Contracting Officer for removal shall be removed by the Contractor and will be paid for by an equitable adjustment to the contract price under the CONTRACT CLAUSE titled "changes". Sampling activities undertaken to determine the presence of additional ACM shall be conducted by personnel who have successfully completed the EPA Model Accreditation Plan (MAP) "Building Inspector" training course required by 40 CFR 763, Subpart E, Appendix C.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

Respiratory Protection Program; G,

Records of the respirator program.

Cleanup and Disposal; G,

Waste shipment records. Weigh bills and delivery tickets shall be furnished for information only.

Detailed Drawings; G,

Descriptions, detail project drawings, and site layout to include worksite containment area techniques as prescribed on applicable SET-UP DETAIL SHEETS, local exhaust ventilation system locations, decontamination units and load-out units, other temporary waste storage facility, access tunnels, location of temporary utilities (electrical, water, sewer) and boundaries of each regulated area.

Materials and Equipment;

Manufacturer's catalog data for all materials and equipment to be used in the work, including brand name, model, capacity, performance characteristics and any other pertinent information. Test results and certificates from the manufacturer of encapsulants substantiating compliance with performance requirements of this specification. Material Safety Data Sheets for all chemicals to be used onsite in the same format as implemented in the Contractor's HAZARD COMMUNICATION PROGRAM. Data shall include, but shall not be limited to, the following items:

- a. High Efficiency Filtered Air (HEPA) local exhaust equipment
- b. Vacuum cleaning equipment
- c. Pressure differential monitor for HEPA local exhaust equipment
- d. Air monitoring equipment
- e. Respirators

f. Personal protective clothing and equipment

- (1) Coveralls
- (2) Underclothing
- (3) Other work clothing
- (4) Foot coverings
- (5) Hard hats
- (6) Eye protection
- (7) Other items required and approved by Contractors

Designated IH and Competent Person

g. Glovebag

h. Duct Tape

i. Disposal Containers

- (1) Disposal bags
- (2) Fiberboard drums
- (3) Paperboard boxes

j. Sheet Plastic

- (1) Polyethylene Sheet - General
- (2) Polyethylene Sheet - Flame Resistant
- (3) Polyethylene Sheet - Reinforced

k. Wetting Agent

- (1) Amended Water
- (2) Removal encapsulant

l. Strippable Coating

m. Prefabricated Decontamination Unit

n. Other items

o. Chemical encapsulant

p. Chemical encasement materials

q. Material Safety Data Sheets (for all chemicals proposed)

Qualifications; G,

A written report providing evidence of qualifications for personnel, facilities and equipment assigned to the work.

Training Program;

A copy of the written project site-specific training material as indicated in 29 CFR 1926, Section .1101 that will be used to train onsite employees. The training document shall be signed by the

Contractor's Designated IH and Competent Person.

Medical Requirements;

Physician's written opinion.

Encapsulants; G,

Certificates stating that encapsulants meet the applicable specified performance requirements.

#### SD-06 Test Reports

Exposure Assessment and Air Monitoring; G,

Initial exposure assessments, negative exposure assessments, air-monitoring results and documentation.

Local Exhaust Ventilation;

Pressure differential recordings.

Licenses, Permits and Notifications; G,

Licenses, permits, and notifications.

#### SD-07 Certificates

Vacuum, Filtration and Ventilation Equipment;

Manufacturer's certifications showing compliance with ANSI Z9.2 for:

- a. Vacuums.
- b. Water filtration equipment.
- c. Ventilation equipment.
- d. Other equipment required to contain airborne asbestos fibers.

### 1.5 QUALIFICATIONS

#### 1.5.1 Written Qualifications and Organization Report

The Contractor shall furnish a written qualifications and organization report providing evidence of qualifications of the Contractor, Contractor's Project Supervisor, Designated Competent Person, supervisors and workers; Designated IH; independent testing laboratory (including name of firm, principal, and analysts who will perform analyses); all subcontractors to be used including disposal transportation and disposal facility firms, subcontractor supervisors, subcontractor workers; and any others assigned to perform asbestos abatement and support activities. The report shall include an organization chart showing the Contractor's staff organization

for this project by name and title, chain of command and reporting relationship with all subcontractors. The report shall be signed by the Contractor, the Contractor's onsite project manager, Designated Competent Person, Designated IH, designated testing laboratory and the principals of all subcontractors to be used. The Contractor shall include the following statement in the report: "By signing this report I certify that the personnel I am responsible for during the course of this project fully understand the contents of 29 CFR 1926, Section .1101, 40 CFR 61, Subpart M, and the federal, state and local requirements specified in paragraph SAFETY AND HEALTH PROGRAM AND PLANS for those asbestos abatement activities that they will be involved in."

#### 1.5.2 Specific Requirements

The Contractor shall designate in writing, personnel meeting the following qualifications:

- a. Designated Competent Person: The name, address, telephone number, and resume of the Contractor's Designated Competent Person shall be provided. Evidence that the full-time Designated Competent Person is qualified in accordance with 29 CFR 1926, Sections .32 and .1101, has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training accreditation required by 40 CFR 763, Subpart E, Appendix C, and is experienced in the administration and supervision of asbestos abatement projects, including exposure assessment and monitoring, work practices, abatement methods, protective measures for personnel, setting up and inspecting asbestos abatement work areas, evaluating the integrity of containment barriers, placement and operation of local exhaust systems, ACM generated waste containment and disposal procedures, decontamination units installation and maintenance requirements, site safety and health requirements, notification of other employees onsite, etc. The duties of the Competent Person shall include the following: controlling entry to and exit from the regulated area; supervising any employee exposure monitoring required by 29 CFR 1926, Section .1101; ensuring that all employees working within a regulated area wear the appropriate personal protective equipment (PPE), are trained in the use of appropriate methods of exposure control, and use the hygiene facilities and decontamination procedures specified; and ensuring that engineering controls in use are in proper operating conditions and are functioning properly. The Designated Competent Person shall be responsible for compliance with applicable federal, state and local requirements, the Contractor's Accident Prevention Plan and Asbestos Hazard Abatement Plan. The Designated Competent Person shall provide, and the Contractor shall submit, the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training with the employee "Certificate of Worker Acknowledgment" required by this paragraph. The Contractor shall submit evidence that this person has a minimum of 2 years of on-the-job asbestos abatement experience relevant to OSHA competent person requirements. The Designated Competent Person shall be onsite at all times during the conduct of this project.

- b. Project and Other Supervisors: The Contractor shall provide the name, address, telephone number, and resume of the Project Supervisor and other supervisors who have responsibility to implement the Accident Prevention Plan, including the Asbestos Hazard Abatement Plan and Activity Hazard Analyses, the authority to direct work performed under this contract and verify compliance, and have EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training accreditation required by 40 CFR 763, Subpart E, Appendix C. The Project Supervisor and other supervisors shall provide, and the Contractor shall submit, the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training with the employee "Certificate of Worker Acknowledgment" required by this paragraph. The Contractor shall submit evidence that the Project Supervisor has a minimum of 2 years of on-the-job asbestos abatement experience relevant to project supervisor responsibilities and the other supervisors have a minimum of 1 year on-the-job asbestos abatement experience commensurate with the responsibilities they will have on this project.
- c. Designated Industrial Hygienist: The Contractor shall provide the name, address, telephone number, resume and other information specified below for the Industrial Hygienist (IH) selected to prepare the Contractor's Asbestos Hazard Abatement Plan, prepare and perform training, direct air monitoring and assist the Contractor's Competent Person in implementing and ensuring that safety and health requirements are complied with during the performance of all required work. The Designated IH shall be a person who is board certified in the practice of industrial hygiene or board eligible (meets all education and experience requirements) as determined and documented by the American Board of Industrial Hygiene (ABIH), has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training accreditation required by 40 CFR 763, Subpart E, Appendix C, and has a minimum of 2 years of comprehensive experience in planning and overseeing asbestos abatement activities. The Designated IH shall provide, and the Contractor shall submit, the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training with the employee "Certificate of Worker Acknowledgment" required by this paragraph. The Designated IH shall be completely independent from the Contractor according to federal, state, or local regulations; that is, shall not be a Contractor's employee or be an employee or principal of a firm in a business relationship with the Contractor negating such independent status. A copy of the Designated IH's current valid ABIH certification shall be included. The Designated IH shall be onsite at all times for the duration of asbestos activities and shall be available for emergencies. In addition, the Designated IH shall prepare, and the Contractor shall submit, the name, address, telephone numbers and resumes of additional IH's and industrial hygiene technicians (IHT) who will be assisting the Designated IH in performing onsite tasks. IHs and IHTs supporting the Designated IH shall have a minimum of 2 years of practical

onsite asbestos abatement experience. The formal reporting relationship between the Designated IH and the support IHs and IHTs, the Designated Competent Person, and the Contractor shall be indicated.

- d. Asbestos Abatement Workers: Asbestos abatement workers shall meet the requirements contained in 29 CFR 1926, Section .1101, 40 CFR 61, Subpart M, and other applicable federal, state and local requirements. Worker training documentation shall be provided as required on the "Certificate of Workers Acknowledgment" in this paragraph.
- e. Worker Training and Certification of Worker Acknowledgment: Training documentation will be required for each employee who will perform OSHA Class I, Class II, Class III, or Class IV asbestos abatement operations. Such documentation shall be submitted on a Contractor generated form titled "Certificate of Workers Acknowledgment", to be completed for each employee in the same format and containing the same information as the example certificate at the end of this section. Training course completion certificates (initial and most recent update refresher) required by the information checked on the form shall be attached.
- f. Physician: The Contractor shall provide the name, medical qualifications, address, telephone number and resume of the physician who will or has performed the medical examinations and evaluations of the persons who will conduct the asbestos abatement work tasks. The physician shall be currently licensed by the state where the workers will be or have been examined, have expertise in pneumoconiosis and shall be responsible for the determination of medical surveillance protocols and for review of examination/test results performed in compliance with 29 CFR 1926, Section .1101 and paragraph MEDICAL REQUIREMENTS. The physician shall be familiar with the site's hazards and the scope of this project.
- g. First Aid and CPR Trained Persons: The names of at least 2 persons who are currently trained in first aid and CPR by the American Red Cross or other approved agency shall be designated and shall be onsite at all times during site operations. They shall be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens Standard of 29 CFR 1910, Section .1030 and shall be included in the Contractor's Bloodborne Pathogen Program. These persons may perform other duties but shall be immediately available to render first aid when needed. A copy of each designated person's current valid First Aid and CPR certificate shall be provided.
- h. Independent Testing Laboratory: The Contractor shall provide the name, address and telephone number of the independent testing laboratory selected to perform the sample analyses and report the results. The testing laboratory shall be completely independent from the Contractor as recognized by federal, state or local regulations. Written verification of the following criteria,

signed by the testing laboratory principal and the Contractor, shall be submitted:

(1) Phase contrast microscopy (PCM): The laboratory is fully equipped and proficient in conducting PCM of airborne samples using the methods specified by 29 CFR 1926, Section .1101, OSHA method ID-160, the most current version of NIOSH 84-100 Method 7400, and NIOSH 84-100 Method 7402, transmission electron microscopy (TEM); the laboratory is currently judged proficient (classified as acceptable) in counting airborne asbestos samples by PCM by successful participation in each of the last 4 rounds in the American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) Program; the names of the selected microscopists who will analyze airborne samples by PCM with verified documentation of their proficiency to conduct PCM analyses by being judged proficient in counting samples as current participating analysts in the AIHA PAT Program, and having successfully completed the Asbestos Sampling and Analysis course (NIOSH 582 or equivalent) with a copy of course completion certificate provided; when the PCM analysis is to be conducted onsite, documentation shall be provided certifying that the onsite analyst meets the same requirements.

(2) Polarized light microscopy (PLM): The laboratory is fully equipped and proficient in conducting PLM analyses of suspect ACM bulk samples in accordance with 40 CFR 763, Subpart E, Appendix E; the laboratory is currently accredited by NIST under the NVLAP for bulk asbestos analysis and will use analysts (names shall be provided) with demonstrated proficiency to conduct PLM to include its application to the identification and quantification of asbestos content.

(3) Transmission electron microscopy (TEM): The laboratory is fully equipped and proficient in conducting TEM analysis of airborne samples using the mandatory method specified by 40 CFR 763, Subpart E, Appendix E; the laboratory is currently accredited by NIST under the NVLAP for airborne sample analysis of asbestos by TEM; the laboratory will use analysts (names shall be provided) that are currently evaluated as competent with demonstrated proficiency under the NIST NVLAP for airborne sample analysis of asbestos by TEM and proficient in conducting analysis for low asbestos concentration, enhanced analysis of floor tiles and bulk materials where multiple layers are present, using an improved EPA test method titled, "Method for the Determination of Asbestos in Bulk Building Materials".

(4) PCM/TEM: The laboratory is fully equipped and each analyst (name shall be provided) possesses demonstrated proficiency in conducting PCM and TEM analysis of airborne samples using NIOSH 84-100 Method 7400 PCM and NIOSH 84-100 Method 7402. TEM confirmation of asbestos content of PCM results from the same filter.

- i. Disposal Facility, Transporter: The Contractor shall provide



written evidence that the landfill to be used is approved for asbestos disposal by the USEPA and Commonwealth of Virginia and local regulatory agencies. Copies of signed agreements between the Contractor (including subcontractors and transporters) and the asbestos waste disposal facility to accept and dispose of all asbestos containing waste generated during the performance of this contract shall be provided. Qualifications shall be provided for each subcontractor or transporter to be used, indicating previous experience in transport and disposal of asbestos waste to include all required state and local waste hauler requirements for asbestos. The Contractor and transporters shall meet the DOT requirements of 49 CFR 171, 49 CFR 172, and 49 CFR 173 as well as registration requirements of 49 CFR 107 and other applicable state or local requirements. The disposal facility shall meet the requirements of 40 CFR 61, Sections .154 or .155, as required in 40 CFR 61, Section .150(b), and other applicable state or local requirements.

#### 1.5.3 Federal, State or Local Citations on Previous Projects

The Contractor and all subcontractors shall submit a statement, signed by an officer of the company, containing a record of any citations issued by Federal, State or local regulatory agencies relating to asbestos activities (including projects, dates, and resolutions); a list of penalties incurred through non-compliance with asbestos project specifications, including liquidated damages, overruns in scheduled time limitations and resolutions; and situations in which an asbestos-related contract has been terminated (including projects, dates, and reasons for terminations). If there are none, a negative declaration signed by an officer of the company shall be provided.

#### 1.6 REGULATORY REQUIREMENTS

In addition to detailed requirements of this specification, work performed under this contract shall comply with EM 385-1-1, applicable federal, state, and local laws, ordinances, criteria, rules and regulations regarding handling, storing, transporting, and disposing of asbestos waste materials. This includes, but is not limited to, OSHA standards, 29 CFR 1926, especially Section .1101, 40 CFR 61, Subpart M and 40 CFR 763. Matters of interpretation of standards shall be submitted to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply. The following state and local laws, rules and regulations regarding demolition, removal, encapsulation, construction alteration, repair, maintenance, renovation, spill/emergency cleanup, housekeeping, handling, storing, transporting and disposing of asbestos material apply:.

#### 1.7 SAFETY AND HEALTH PROGRAM AND PLANS

The Contractor shall develop and submit a written comprehensive site-specific Accident Prevention Plan at least 30 days prior to the preconstruction conference. The Accident Prevention Plan shall address

requirements of EM 385-1-1, Appendix A, covering onsite work to be performed by the Contractor and subcontractors. The Accident Prevention Plan shall incorporate an Asbestos Hazard Abatement Plan, and Activity Hazard Analyses as separate appendices into 1 site specific Accident Prevention Plan document. Any portions of the Contractor's overall Safety and Health Program that are referenced in the Accident Prevention Plan, e.g., respirator program, hazard communication program, confined space entry program, etc., shall be included as appendices to the Accident Prevention Plan. The plan shall take into consideration all the individual asbestos abatement work tasks identified in Table 1. The plan shall be prepared, signed (and sealed, including certification number if required), and dated by the Contractor's Designated IH, Competent Person, and Project Supervisor.

#### 1.7.1 Asbestos Hazard Abatement Plan Appendix

The Asbestos Hazard Abatement Plan appendix to the Accident Prevention Plan shall include, but not be limited to, the following:

- a. The personal protective equipment to be used;
- b. The location and description of regulated areas including clean and dirty areas, access tunnels, and decontamination unit (clean room, shower room, equipment room, storage areas such as load-out unit);
- c. Initial exposure assessment in accordance with 29 CFR 1926, Section .1101;
- d. Level of supervision;
- e. Method of notification of other employers at the worksite;
- f. Abatement method to include containment and control procedures;
- g. Interface of trades involved in the construction;
- h. Sequencing of asbestos related work;
- i. Storage and disposal procedures and plan;
- j. Type of wetting agent and asbestos encapsulant to be used;
- k. Location of local exhaust equipment;
- l. Air monitoring methods (personal, environmental and clearance);
- m. Bulk sampling and analytical methods (if required);
- n. A detailed description of the method to be employed in order to control the spread of ACM wastes and airborne fiber concentrations;
- o. Fire and medical emergency response procedures;

p. The security procedures to be used for all regulated areas.

#### 1.7.2 Activity Hazard Analyses Appendix

Activity Hazard Analyses, for each major phase of work, shall be submitted and updated during the project. The Activity Hazard Analyses format shall be in accordance with EM 385-1-1 (Figure 1-1). The analysis shall define the activities to be performed for a major phase of work, identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. Work shall not proceed on that phase until the Activity Hazard Analyses has been accepted and a preparatory meeting has been conducted by the Contractor to discuss its contents with everyone engaged in the activities, including the onsite Government representatives. The Activity Hazard Analyses shall be continuously reviewed and, when appropriate, modified to address changing site conditions or operations.

#### 1.8 PRECONSTRUCTION CONFERENCE AND ONSITE SAFETY

The Contractor and the Contractor's Designated Competent Person, Project Supervisor, and Designated IH shall meet with the Contracting Officer prior to beginning work at a safety preconstruction conference to discuss the details of the Contractor's submitted Accident Prevention Plan to include the Asbestos Hazard Abatement Plan and Activity Hazard Analyses appendices. Deficiencies in the Accident Prevention Plan will be discussed and the Accident Prevention Plan shall be revised to correct the deficiencies and resubmitted for acceptance. Any changes required in the specification as a result of the Accident Prevention Plan shall be identified specifically in the plan to allow for free discussion and acceptance by the Contracting Officer, prior to the start of work. Onsite work shall not begin until the Accident Prevention Plan has been accepted. A copy of the written Accident Prevention Plan shall be maintained onsite. Changes and modifications to the accepted Accident Prevention Plan shall be made with the knowledge and concurrence of the Designated IH, the Project Supervisor, Designated Competent Person, and the Contracting Officer. Should any unforeseen hazard become evident during the performance of the work, the Designated IH shall bring such hazard to the attention of the Project Supervisor, Designated Competent Person, and the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, all necessary action shall be taken by the Contractor to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Once accepted by the Contracting Officer, the Accident Prevention Plan, including the Asbestos Hazard Abatement Plan and Activity Hazard Analyses will be enforced as if an addition to the contract. Disregarding the provisions of this contract or the accepted Accident Prevention Plan will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

#### 1.9 SECURITY

Fenced and locked security area shall be provided for each regulated area. A log book shall be kept documenting entry into and out of the regulated area. Entry into regulated areas shall only be by personnel authorized by the Contractor and the Contracting Officer. Personnel authorized to enter

regulated areas shall be trained, be medically evaluated, and wear the required personal protective equipment for the specific regulated area to be entered.

#### 1.10 MEDICAL REQUIREMENTS

Medical requirements shall conform to 29 CFR 1926, Section .1101.

##### 1.10.1 Medical Examinations

Before being exposed to airborne asbestos fibers, workers shall be provided with a medical examination as required by 29 CFR 1926, Section .1101 and other pertinent state or local requirements. This requirement shall have been satisfied within the last 12 months. The same medical examination shall be given on an annual basis to employees engaged in an occupation involving asbestos and within 30 calendar days before or after the termination of employment in such occupation. X-ray films of asbestos workers shall be identified to the consulting radiologist and medical record jackets shall be marked with the word "asbestos."

##### 1.10.1.1 Information Provided to the Physician

The Contractor shall provide the following information in writing to the examining physician:

- a. A copy of 29 CFR 1926, Section .1101 and Appendices D, E, G, and I;
- b. A description of the affected employee's duties as they relate to the employee's exposure;
- c. The employee's representative exposure level or anticipated exposure level;
- d. A description of any personal protective and respiratory equipment used or to be used;
- e. Information from previous medical examinations of the affected employee that is not otherwise available to the examining physician.

##### 1.10.1.2 Written Medical Opinion

For each worker, a written medical opinion prepared and signed by a licensed physician indicating the following:

- a. Summary of the results of the examination.
- b. The potential for an existing physiological condition that would place the employee at an increased risk of health impairment from exposure to asbestos.
- c. The ability of the individual to wear personal protective equipment, including respirators, while performing strenuous work tasks under cold and/or heat stress conditions.

- d. A statement that the employee has been informed of the results of the examination, provided with a copy of the results, informed of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure, and informed of any medical condition that may result from asbestos exposure.

#### 1.10.2 Medical and Exposure Records

Complete and accurate records shall be maintained of each employee's medical examinations, medical records, and exposure data, as required by 29 CFR 1910, Section .1910.20 and 29 CFR 1926, Section .1101 for a period of 50 years after termination of employment. Records of the required medical examinations and exposure data shall be made available, for inspection and copying, to the Assistant Secretary of Labor for Occupational Safety and Health (OSHA) or authorized representatives of the employee and an employee's physician upon request of the employee or former employee. A copy of the required medical certification for each employee shall be maintained on file at the worksite for review, as requested by the Contracting Officer or the representatives.

#### 1.11 TRAINING PROGRAM

##### 1.11.1 General Training Requirements

The Contractor shall establish a training program as specified by EPA Model Accreditation Plan (MAP), training requirements at 40 CFR 763, Subpart E, Appendix C, the applicable Commonwealth of Virginia regulatory training requirements, OSHA requirements at 29 CFR 1926, Section .1101(k)(9), and this specification. Contractor employees shall complete the required training for the type of work they are to perform and such training shall be documented and provided to the Contracting Officer as specified in paragraph QUALIFICATIONS.

##### 1.11.2 Project Specific Training

Prior to commencement of work, each worker shall be instructed by the Contractor's Designated IH and Competent Person in the following project specific training:

- a. The hazards and health effects of the specific types of ACM to be abated;
- b. The content and requirements of the Contractor's Accident Prevention Plan to include the Asbestos Hazard Abatement Plan and Activity Hazard Analyses and site-specific safety and health precautions;
- c. Hazard Communication Program;
- d. Hands-on training for each asbestos abatement technique to be employed;
- e. Heat and/or cold stress monitoring specific to this project;

- f. Air monitoring program and procedures;
- g. Medical surveillance to include medical and exposure record-keeping procedures;
- h. The association of cigarette smoke and asbestos-related disease;
- i. Security procedures;
- j. Specific work practice controls and engineering controls required for each Class of work in accordance with 29 CFR 1926, Section .1101.

#### 1.12 RESPIRATORY PROTECTION PROGRAM

The Contractor's Designated IH shall establish in writing, and implement a respiratory protection program in accordance with 29 CFR 1926, Section .1101, 29 CFR 1910, Section .134, ANSI Z88.2, CGA G-7, CGA G-7.1 and DETAIL SHEET 12. The Contractor's Designated IH shall establish minimum respiratory protection requirements based on measured or anticipated levels of airborne asbestos fiber concentrations encountered during the performance of the asbestos abatement work. The Contractor's respiratory protection program shall include, but not be limited to, the following elements:

- a. The company policy, used for the assignment of individual responsibility, accountability, and implementation of the respiratory protection program.
- b. The standard operating procedures covering the selection and use of respirators. Respiratory selection shall be determined by the hazard to which the worker is exposed.
- c. Medical evaluation of each user to verify that the worker may be assigned to an activity where respiratory protection is required.
- d. Training in the proper use and limitations of respirators.
- e. Respirator fit-testing, i.e., quantitative, qualitative and individual functional fit checks.
- f. Regular cleaning and disinfection of respirators.
- g. Routine inspection of respirators during cleaning and after each use when designated for emergency use.
- h. Storage of respirators in convenient, clean, and sanitary locations.
- i. Surveillance of regulated area conditions and degree of employee exposure (e.g., through air monitoring).
- j. Regular evaluation of the continued effectiveness of the respiratory protection program.

- k. Recognition and procedures for the resolution of special problems as they affect respirator use (e.g., no facial hair that comes between the respirator face piece and face or interferes with valve function; prescription eye wear usage; contact lenses usage; etc.).
- l. Proper training in putting on and removing respirators.

#### 1.12.1 Respiratory Fit Testing

A qualitative or quantitative fit test conforming to 29 CFR 1926, Section 1101, Appendix C shall be conducted by the Contractor's Designated IH for each Contractor worker required to wear a respirator, and for the Contracting Officer and authorized visitors who enter a regulated area where respirators are required to be worn. A respirator fit test shall be performed for each worker wearing a negative-pressure respirator prior to initially wearing a respirator on this project and every 6 months thereafter. The qualitative fit tests may be used only for testing the fit of half-mask respirators where they are permitted to be worn, or of full-facepiece air purifying respirators where they are worn at levels at which half-facepiece air purifying respirators are permitted. If physical changes develop that will affect the fit, a new fit test for the worker shall be performed. Functional fit checks shall be performed by employees each time a respirator is put on and in accordance with the manufacturer's recommendation.

#### 1.12.2 Respirator Selection and Use Requirements

The Contractor shall provide respirators, and ensure that they are used as required by 29 CFR 1926, Section .1101 and in accordance with the manufacturer's recommendations. Respirators shall be jointly approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health (MSHA/NIOSH), or by NIOSH, under the provisions of 42 CFR 84, for use in environments containing airborne asbestos fibers. Personnel who handle ACM, enter regulated areas that require the wearing of a respirator, or who are otherwise carrying out abatement activities that require the wearing of a respirator, shall be provided with approved respirators that are fully protective of the worker at the measured or anticipated airborne asbestos concentration level to be encountered. For air-purifying respirators, the particulate filter portion of the cartridges or canister approved for use in airborne asbestos environments shall be high-efficiency particulate air (HEPA). The initial respirator selection and the decisions regarding the upgrading or downgrading of respirator type shall be made by the Contractor's Designated IH based on the measured or anticipated airborne asbestos fiber concentrations to be encountered. Recommendations made by the Contractor's Designated IH to downgrade respirator type shall be submitted in writing to the Contracting Officer. The Contractor's Designated Competent Person in consultation with the Designated IH, shall have the authority to take immediate action to upgrade or downgrade respiratory type when there is an immediate danger to the health and safety of the wearer. Respirators shall be used in the following circumstances:

- a. During all Class I asbestos jobs.
- b. During all Class II work where the ACM is not removed in a substantially intact state.
- c. During all Class II and III work which is not performed using wet methods. Respirators need not be worn during removal of ACM from sloped roofs when a negative exposure assessment has been made and ACM is removed in an intact state.
- d. During all Class II and III asbestos jobs where the Contractor does not produce a negative exposure assessment.
- e. During all Class III jobs where TSI or surfacing ACM is being disturbed.
- f. During all Class IV work performed within regulated areas where employees performing other work are required to wear respirators.
- g. During all work where employees are exposed above the PEL-TWA or PEL-Excursion Limit.
- h. In emergencies

#### 1.12.3 Class I Work

The Contractor shall provide: (1) a tight-fitting, powered air purifying respirator equipped with high efficiency filters, or (2) a full-facepiece supplied air respirator operated in the pressure demand mode, equipped with HEPA egress cartridges, or (3) an auxiliary positive pressure self-contained breathing apparatus, for all employees within the regulated area where Class I work is being performed; provided that a negative exposure assessment has not been produced, and that the exposure level will not exceed 1 f/cc as an 8-hour time weighted average. A full-facepiece supplied air respirator, operated in the pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus shall be provided under such conditions, if the exposure assessment indicates exposure levels above 1 f/cc as an 8-hour time weighted average.

#### 1.12.4 Class II and III Work

The Contractor shall provide an air purifying respirator, other than a disposable respirator, equipped with high-efficiency filters whenever the employee performs Class II and III asbestos jobs where the Contractor does not produce a negative exposure assessment ; and Class III jobs where TSI or surfacing ACM is being disturbed.

#### 1.12.5 Sanitation

Employees who wear respirators shall be permitted to leave work areas to wash their faces and respirator facepieces whenever necessary to prevent skin irritation associated with respirator use.



## 1.13 HAZARD COMMUNICATION PROGRAM

A hazard communication program shall be established and implemented in accordance with 29 CFR 1926, Section .59. Material safety data sheets (MSDSs) shall be provided for all hazardous materials brought onto the worksite. One copy shall be provided to the Contracting Officer and 1 copy shall be included in the Contractor's Hazard Communication Program.

## 1.14 LICENSES, PERMITS AND NOTIFICATIONS

## 1.14.1 General Legal Requirements

Necessary licenses, permits and notifications shall be obtained in conjunction with the project's asbestos abatement, transportation and disposal actions and timely notification furnished of such actions as required by federal, state, regional, and local authorities. The Contractor shall inform the Government and will notify the USEPA Region III Office, the Commonwealth of Virginia Department of Environmental Quality, and the Contracting Officer in writing, at least 10 days prior to the commencement of work, in accordance with 40 CFR 61, Subpart M, and state and local requirements to include the mandatory "Notification of Demolition and Renovation Record" form and other required notification documents. Notification shall be by Certified Mail, Return Receipt Requested. The Contractor shall furnish copies of the receipts to the Contracting Officer, in writing, prior to the commencement of work. Local fire department shall be notified 3 days before fire-proofing material is removed from a building and the notice shall specify whether or not the material contains asbestos.

A copy of the rental company's written acknowledgment and agreement shall be provided as required by paragraph RENTAL EQUIPMENT. For licenses, permits, and notifications that the Contractor is responsible for obtaining, the Contractor shall pay any associated fees or other costs incurred.

## 1.14.2 Litigation and Notification

The Contractor shall notify the Contracting Officer if any of the following occur:

- a. The Contractor or any of the subcontractors are served with notice of violation of any law, regulation, permit or license which relates to this contract;
- b. Proceedings are commenced which could lead to revocation of related permits or licenses; permits, licenses or other Government authorizations relating to this contract are revoked;
- c. Litigation is commenced which would affect this contract;
- d. The Contractor or any of the subcontractors become aware that their equipment or facilities are not in compliance or may fail to comply in the future with applicable laws or regulations.

## 1.15 PERSONAL PROTECTIVE EQUIPMENT

Three complete sets of personal protective equipment shall be made available to the Contracting Officer and authorized visitors for entry to the regulated area. Contracting Officer and authorized visitors shall be provided with training equivalent to that provided to Contractor employees in the selection, fitting, and use of the required personal protective equipment and the site safety and health requirements. Contractor workers shall be provided with personal protective clothing and equipment and the Contractor shall ensure that it is worn properly. The Contractor's Designated IH and Designated Competent Person shall select and approve all the required personal protective clothing and equipment to be used.

## 1.15.1 Respirators

Respirators shall be in accordance with paragraph RESPIRATORY PROTECTION PROGRAM.

## 1.15.2 Whole Body Protection

Personnel exposed to airborne concentrations of asbestos that exceed the PELs, or for all OSHA Classes of work for which a required negative exposure assessment is not produced, shall be provided with whole body protection and such protection shall be worn properly. The Contractor's Designated IH and Competent Person shall select and approve the whole body protection to be used. The Competent Person shall examine work suits worn by employees at least once per work shift for rips or tears that may occur during performance of work. When rips or tears are detected while an employee is working, rips and tears shall be immediately mended, or the work suit shall be immediately replaced. Disposable whole body protection shall be disposed of as asbestos contaminated waste upon exiting from the regulated area. Reusable whole body protection worn shall be either disposed of as asbestos contaminated waste upon exiting from the regulated area or be properly laundered in accordance with 29 CFR 1926, Section .1101.

Whole body protection used for asbestos abatement shall not be removed from the worksite by a worker to be cleaned. Recommendations made by the Contractor's Designated IH to downgrade whole body protection shall be submitted in writing to the Contracting Officer. The Contractor's Designated Competent Person, in consultation with the Designated IH, has the authority to take immediate action to upgrade or downgrade whole body protection when there is an immediate danger to the health and safety of the wearer.

## 1.15.2.1 Coveralls

Disposable-impermeable or Disposable-breathable coveralls with a zipper front shall be provided. Sleeves shall be secured at the wrists, and foot coverings secured at the ankles. See DETAIL SHEET 13.

## 1.15.2.2 Underwear

Disposable underwear shall be provided. If reusable underwear are used, they shall be disposed of as asbestos contaminated waste or laundered in accordance with 29 CFR 1926, Section .1101. Asbestos abatement workers

shall not remove contaminated reusable underwear worn during abatement of ACM from the site to be laundered.

#### 1.15.2.3 Work Clothing

An additional coverall shall be provided when the abatement and control method employed does not provide for the exit from the regulated area directly into an attached decontamination unit. Cloth work clothes for wear under the protective coverall, and foot coverings, shall be provided when work is being conducted in low temperature conditions. Cloth work clothes shall be either disposed of as asbestos contaminated waste or properly laundered in accordance with 29 CFR 1926, Section .1101.

#### 1.15.2.4 Gloves

Gloves shall be provided to protect the hands. Where there is the potential for hand injuries (i.e., scrapes, punctures, cuts, etc.) a suitable glove shall be provided and used.

#### 1.15.2.5 Foot Coverings

Cloth socks shall be provided and worn next to the skin. Footwear, as required by OSHA and EM 385-1-1, that is appropriate for safety and health hazards in the area shall be worn. Rubber boots shall be used in moist or wet areas. Reusable footwear removed from the regulated area shall be thoroughly decontaminated or disposed of as ACM waste. Disposable protective foot covering shall be disposed of as ACM waste. If rubber boots are not used, disposable foot covering shall be provided.

#### 1.15.2.6 Head Covering

Hood type disposable head covering shall be provided. In addition, protective head gear (hard hats) shall be provided as required. Hard hats shall only be removed from the regulated area after being thoroughly decontaminated.

#### 1.15.2.7 Protective Eye Wear

Eye protection provided shall be in accordance with ANSI Z87.1.

### 1.16 HYGIENE FACILITIES AND PRACTICES

The Contractor shall establish a decontamination area for the decontamination of employees, material and equipment. The Contractor shall ensure that employees enter and exit the regulated area through the decontamination area.

#### 1.16.1 Shower Facilities

Shower facilities, when provided, shall comply with 29 CFR 1910, Section .141(d)(3).

#### 1.16.2 3-Stage Decontamination Area

A temporary negative pressure decontamination unit that is adjacent and

attached in a leak-tight manner to the regulated area shall be provided as described in SET-UP DETAIL SHEET Numbers 22 and 23. Utilization of prefabricated units shall have prior approval of the Contracting Officer. The decontamination unit shall have an equipment room and a clean room separated by a shower that complies with 29 CFR 1910, Section .141 (unless the Contractor can demonstrate that such facilities are not feasible). Equipment and surfaces of containers filled with ACM shall be cleaned prior to removing them from the equipment room or area. Surfaces of the equipment room shall be wet wiped 2 times after each shift. Materials used for wet wiping shall be disposed of as asbestos contaminated waste. Two separate lockers shall be provided for each asbestos worker, one in the equipment room and one in the clean room. Hot water service may be secured from the building hot water system provided backflow protection is installed by the Contractor at the point of connection and when permission is obtained from the Contracting Officer or the Government. Should sufficient hot water be unavailable, the Contractor shall provide a minimum 40 gal. electric water heater with minimum recovery rate of 20 gal. per hour and a temperature controller for each showerhead. The Contractor shall provide a minimum of 2 showers. Instantaneous type in-line water heater may be incorporated at each shower head in lieu of hot water heater, upon approval by the Contracting Officer. Flow and temperature controls shall be located within the shower and shall be adjustable by the user. The wastewater pump shall be sized for 1.25 times the showerhead flow-rate at a pressure head sufficient to satisfy the filter head loss and discharge line losses. The pump shall supply a minimum 25 gpm flow with 35 ft. of pressure head. Used shower water shall be collected and filtered to remove asbestos contamination. Filters and residue shall be disposed of as asbestos contaminated material, per DETAIL SHEETS 9 and 14. Filtered water shall be discharged to the sanitary system. Wastewater filters shall be installed in series with the first stage pore size of 20 microns and the second stage pore size of 5 microns. The floor of the decontamination unit's clean room shall be kept dry and clean at all times. Water from the shower shall not be allowed to wet the floor in the clean room. Surfaces of the clean room and shower shall be wet-wiped 2 times after each shift change with a disinfectant solution. Proper housekeeping and hygiene requirements shall be maintained. Soap and towels shall be provided for showering, washing and drying. Any cloth towels provided shall be disposed of as ACM waste or shall be laundered in accordance with 29 CFR 1926, Section .1101.

#### 1.16.3 Load-Out Unit

A temporary load-out unit that is adjacent and connected to the regulated area and access tunnel shall be provided as described in DETAIL SHEET Number 20 and 25. Utilization of prefabricated units shall have prior approval of the Contracting Officer. The load-out unit shall be attached in a leak-tight manner to each regulated area. Surfaces of the load-out unit and access tunnel shall be adequately wet-wiped 2 times after each shift change. Materials used for wet wiping shall be disposed of as asbestos contaminated waste.

#### 1.16.4 Single Stage Decontamination Area

A decontamination area (equipment room/area) shall be provided for Class I

work involving less than 25 feet or 10 square feet of TSI or surfacing ACM, and for Class II and Class III asbestos work operations where exposures exceed the PELs or where there is no negative exposure assessment produced before the operation. The equipment room or area shall be adjacent to the regulated area for the decontamination of employees, material, and their equipment which is contaminated with asbestos. The equipment room or area shall consist of an area covered by an impermeable drop cloth on the floor or horizontal working surface. The area must be of sufficient size to accommodate cleaning of equipment and removing personal protective equipment without spreading contamination beyond the area. Surfaces of the equipment room shall be wet wiped 2 times after each shift. Materials used for wet wiping shall be disposed of as asbestos contaminated waste.

#### 1.16.5 Decontamination Requirements for Class IV Work

The Contractor shall ensure that employees performing Class IV work within a regulated area comply with the hygiene practice required of employees performing work which has a higher classification within that regulated area, or the Contractor shall provide alternate decontamination area facilities for employees cleaning up debris and material which is TSI or surfacing ACM.

#### 1.16.6 Decontamination Area Entry Procedures

The Contractor shall ensure that employees entering the decontamination area through the clean room or clean area:

- a. Remove street clothing in the clean room or clean area and deposit it in lockers.
- b. Put on protective clothing and respiratory protection before leaving the clean room or clean area.
- c. Pass through the equipment room to enter the regulated area.

#### 1.16.7 Decontamination Area Exit Procedures

The Contractor shall ensure that the following procedures are followed:

- a. Before leaving the regulated area, respirators shall be worn while employees remove all gross contamination and debris from their work clothing using a HEPA vacuum.
- b. Employees shall remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers (see Detail Sheets 9 and 14) for disposal and/or laundering.
- c. Employees shall not remove their respirators in the equipment room.
- d. Employees shall shower prior to entering the clean room. If a shower has not been located between the equipment room and the clean room or the work is performed outdoors, the Contractor shall

ensure that employees engaged in Class I asbestos jobs: a) Remove asbestos contamination from their work suits in the equipment room or decontamination area using a HEPA vacuum before proceeding to a shower that is not adjacent to the work area; or b) Remove their contaminated work suits in the equipment room, without cleaning worksuits, and proceed to a shower that is not adjacent to the work area.

- e. After showering, employees shall enter the clean room before changing into street clothes.

#### 1.16.8 Lunch Areas

The Contractor shall provide lunch areas in which the airborne concentrations of asbestos are below 0.01 f/cc.

#### 1.16.9 Smoking

Smoking, if allowed by the Contractor, shall only be permitted in designated areas approved by the Contracting Officer.

#### 1.17 REGULATED AREAS

All Class I, II, and III asbestos work shall be conducted within regulated areas. The regulated area shall be demarcated to minimize the number of persons within the area and to protect persons outside the area from exposure to airborne asbestos. Where critical barriers or negative pressure enclosures are used, they shall demarcate the regulated area. Access to regulated areas shall be limited to authorized persons. The Contractor shall control access to regulated areas, ensure that only authorized personnel enter, and verify that Contractor required medical surveillance, training and respiratory protection program requirements are met prior to allowing entrance.

#### 1.18 WARNING SIGNS AND TAPE

Warning signs and tape printed bilingually in English and Spanish shall be provided at the regulated boundaries and entrances to regulated areas. The Contractor shall ensure that all personnel working in areas contiguous to regulated areas comprehend the warning signs. Signs shall be located to allow personnel to read the signs and take the necessary protective steps required before entering the area. Warning signs, as shown and described in DETAIL SHEET 11, shall be in vertical format conforming to 29 CFR 1910 and 29 CFR 1926, Section .1101, a minimum of 20 by 14 inches, and displaying the following legend in the lower panel:

DANGER  
ASBESTOS  
CANCER AND LUNG DISEASE HAZARD  
AUTHORIZED PERSONNEL ONLY  
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

Spacing between lines shall be at least equal to the height of the upper of any two lines. Warning tape shall be provided as shown and described on

DETAIL SHEET 11. Decontamination unit signage shall be as shown and described on DETAIL SHEET 15.

#### 1.19 WARNING LABELS

Warning labels shall be affixed to all asbestos disposal containers used to contain asbestos materials, scrap, waste debris, and other products contaminated with asbestos. Containers with preprinted warning labels conforming to requirements are acceptable. Warning labels shall be as described in DETAIL SHEET 14, shall conform to 29 CFR 1926, Section .1101 and shall be of sufficient size to be clearly legible displaying the following legend:

DANGER  
CONTAINS ASBESTOS FIBERS  
AVOID CREATING DUST  
CANCER AND LUNG DISEASE HAZARD

#### 1.20 LOCAL EXHAUST VENTILATION

Local exhaust ventilation units shall conform to ANSI Z9.2 and 29 CFR 1926, Section .1101. Filters on local exhaust system equipment shall conform to ANSI Z9.2 and UL 586. Filter shall be UL labeled.

#### 1.21 TOOLS

Vacuums shall be leak proof to the filter, equipped with HEPA filters, of sufficient capacity and necessary capture velocity at the nozzle or nozzle attachment to efficiently collect, transport and retain the ACM waste material. Power tools shall not be used to remove ACM unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation capture and collection system, or has otherwise been approved for use by the Contracting Officer. Residual asbestos shall be removed from reusable tools prior to storage and reuse. Reusable tools shall be thoroughly decontaminated prior to being removed from regulated areas.

#### 1.22 RENTAL EQUIPMENT

If rental equipment is to be used, written notification shall be provided to the rental agency, concerning the intended use of the equipment, the possibility of asbestos contamination of the equipment and the steps that will be taken to decontaminate such equipment. A written acceptance of the terms of the Contractor's notification shall be obtained from the rental agency.

#### 1.23 AIR MONITORING EQUIPMENT

The Contractor's Designated IH shall approve air monitoring equipment to be used to collect samples. The equipment shall include, but shall not be limited to:

- a. High-volume sampling pumps that can be calibrated and operated at a constant airflow up to 16 liters per minute when equipped with a sampling train of tubing and filter cassette.

- b. Low-volume, battery powered, body-attachable, portable personal pumps that can be calibrated to a constant airflow up to approximately 3.5 liters per minute when equipped with a sampling train of tubing and filter cassette, and a self-contained rechargeable power pack capable of sustaining the calibrated flow rate for a minimum of 10 hours. The pumps shall also be equipped with an automatic flow control unit which shall maintain a constant flow, even as filter resistance increases due to accumulation of fiber and debris on the filter surface.
- c. Single use standard 25 mm diameter cassette, open face, 0.8 micron pore size, mixed cellulose ester membrane filters and cassettes with 50 mm electrically conductive extension cowl, and shrink bands, to be used with low flow pumps in accordance with 29 CFR 1926, Section .1101 for personal air sampling.
- d. Single use standard 25 mm diameter cassette, open face, 0.45 micron pore size, mixed cellulose ester membrane filters and cassettes with 50 mm electrically conductive cowl, and shrink bands, to be used with high flow pumps when conducting environmental area sampling using NIOSH 84-100 Methods 7400 and 7402, (and the transmission electric microscopy method specified at 40 CFR 763 if required).
- e. Appropriate plastic tubing to connect the air sampling pump to the selected filter cassette.
- f. A flow calibrator capable of calibration to within plus or minus 2 percent of reading over a temperature range of minus 4 to plus 140 degrees F and traceable to a NIST primary standard.

#### 1.24 EXPENDABLE SUPPLIES

##### 1.24.1 Glovebag

Glovebags shall be provided as described in 29 CFR 1926, Section .1101 and SET-UP DETAIL SHEET 10. The glovebag assembly shall be 6 mil thick plastic, prefabricated and seamless at the bottom with preprinted OSHA warning label.

##### 1.24.2 Duct Tape

Industrial grade duct tape of appropriate widths suitable for bonding sheet plastic and disposal container shall be provided.

##### 1.24.3 Disposal Containers

Leak-tight (defined as solids, liquids, or dust that cannot escape or spill



out) disposal containers shall be provided for ACM wastes as required by 29 CFR 1926 Section .1101 and DETAIL SHEETS 9A, 9B, 9C and 14.

#### 1.24.4 Disposal Bags

Leak-tight bags, 6 mil thick, shall be provided for placement of asbestos generated waste as described in DETAIL SHEET 9A.

#### 1.24.5 Fiberboard Drums

Fiberboard drums shall be used as necessary.

#### 1.24.6 Cardboard Boxes

Heavy-duty corrugated cardboard boxes, coated with plastic or wax to retard deterioration from moisture, shall be provided as described in DETAIL SHEET 9C, if required by state and local requirements. Boxes shall fit into selected ACM disposal bags. Filled boxes shall be sealed leak-tight with duct tape.

#### 1.24.7 Sheet Plastic

Sheet plastic shall be polyethylene of 6 mil minimum thickness and shall be provided in the largest sheet size necessary to minimize seams, as indicated on the project drawings. Film shall be clear, frosted, or black and conform to ASTM D 4397, except as specified below:

##### 1.24.7.1 Flame Resistant

Where a potential for fire exists, flame-resistant sheets shall be provided. Film shall be frosted or black and shall conform to the requirements of NFPA 701.

##### 1.24.7.2 Reinforced

Reinforced sheets shall be provided where high skin strength is required, such as where it constitutes the only barrier between the regulated area and the outdoor environment. The sheet stock shall consist of translucent, nylon-reinforced or woven-polyethylene thread laminated between 2 layers of polyethylene film. Film shall meet flame resistant standards of NFPA 701.

#### 1.24.8 Amended Water

Amended water shall meet the requirements of ASTM D 1331.

#### 1.24.9 Mastic Removing Solvent

Mastic removing solvent shall be nonflammable and shall not contain methylene chloride, glycol ether, or halogenated hydrocarbons. Solvents used onsite shall have a flash point greater than 140 degrees F.

#### 1.24.10 Leak-tight Wrapping

Two layers of 6 mil minimum thick polyethylene sheet stock shall be used

for the containment of removed asbestos-containing components or materials such as reactor vessels, large tanks, boilers, insulated pipe segments and other materials too large to be placed in disposal bags as described in DETAIL SHEET 9B. Upon placement of the ACM component or material, each layer shall be individually leak-tight sealed with duct tape.

#### 1.24.11 Viewing Inspection Window

Where feasible, a minimum of 1 clear, 1/8 inch thick, acrylic sheet, 18 by 24 inches, shall be installed as a viewing inspection window at eye level on a wall in each containment enclosure. The windows shall be sealed leak-tight with industrial grade duct tape.

#### 1.24.12 Wetting Agents

Removal encapsulant (a penetrating encapsulant) shall be provided when conducting removal abatement activities that require a longer removal time or are subject to rapid evaporation of amended water. The removal encapsulant shall be capable of wetting the ACM and retarding fiber release during disturbance of the ACM greater than or equal to that provided by amended water. Performance requirements for penetrating encapsulants are specified in paragraph ENCAPSULANTS.

#### 1.24.13 Strippable Coating

Strippable coating in aerosol cans shall be used to adhere to surfaces and to be removed cleanly by stripping, at the completion of work. This work shall only be done in well ventilated areas.

#### 1.25 MISCELLANEOUS ITEMS

A sufficient quantity of other items, such as, but not limited to: scrapers, brushes, brooms, staple guns, tarpaulins, shovels, rubber squeegees, dust pans, other tools, scaffolding, staging, enclosed chutes, wooden ladders, lumber necessary for the construction of containments, UL approved temporary electrical equipment, material and cords, ground fault circuit interrupters, water hoses of sufficient length, fire extinguishers, first aid kits, portable toilets, logbooks, log forms, markers with indelible ink, spray paint in bright color to mark areas, project boundary fencing, etc., shall be provided.

### PART 2 PRODUCTS

#### 2.1 ENCAPSULANTS

Encapsulants shall conform to USEPA requirements, shall contain no toxic or hazardous substances and no solvent and shall meet the following requirements:

## ALL ENCAPSULANTS

Requirement	Test Standard
Flame Spread - 25, Smoke Emission - 50	ASTM E 84
Combustion Toxicity Zero Mortality	Univ. of Pittsburgh Protocol
Life Expectancy, 20 yrs Accelerated Aging Test	ASTM C 732
Permeability, Minimum 0.4 perms	ASTM E 96

## Additional Requirements for Bridging Encapsulant

Requirement	Test Standard
Cohesion/Adhesion Test, 50 pounds of force/foot	ASTM E 736
Fire Resistance, Negligible affect on fire resistance rating over 3 hour test (Classified by UL for use over fibrous and cementitious sprayed fireproofing)	ASTM E 119
Impact Resistance, Minimum 43 in-lb (Gardner Impact Test)	ASTM D 2794
Flexibility, no rupture or cracking (Mandrel Bend Test)	ASTM D 522

## Additional Requirements for Penetrating Encapsulant

Requirement	Test Standard
Cohesion/Adhesion Test, 50 pounds of force/foot	ASTM E 736
Fire Resistance, Negligible affect on fire resistance rating over 3 hour test (Classified by UL for use over fibrous and cementitious sprayed fireproofing)	ASTM E 119
Impact Resistance, Minimum 43 in-lb (Gardner Impact Test)	ASTM D 2794
Flexibility, no rupture or cracking (Mandrel Bend Test)	ASTM D 522

## Additional Requirements for Lockdown Encapsulant

Requirement	Test Standard
Fire Resistance, Negligible affect on fire resistance	ASTM E 119

## ALL ENCAPSULANTS

Requirement	Test Standard
rating over 3 hour test (Tested with fireproofing over encapsulant applied directly to steel member)	
Bond Strength, 100 pounds of force/foot (Tests compatibility with cementitious and fibrous fireproofing)	ASTM E 736

## 2.2 ENCASEMENT PRODUCTS

Encasement shall consist of primary cellular polymer coat, polymer finish coat, and any other finish coat as approved by the Contracting Officer.

## 2.3 RECYCLABLE MATERIALS

The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

## PART 3 EXECUTION

## 3.1 GENERAL REQUIREMENTS

Asbestos abatement work tasks shall be performed as shown on the detailed plans and drawings, as summarized in paragraph DESCRIPTION OF WORK and including Table 1 and the Contractor's Accident Prevention Plan, Asbestos Hazard Abatement Plan, and the Activity Hazard Analyses. The Contractor shall use the engineering controls and work practices required in 29 CFR 1926, Section .1101(g) in all operations regardless of the levels of exposure. Personnel shall wear and utilize protective clothing and equipment as specified. The Contractor shall not permit eating, smoking, drinking, chewing or applying cosmetics in the regulated area. All hot work (burning, cutting, welding, etc.) shall be conducted under controlled conditions in conformance with 29 CFR 1926, Section .352, Fire Prevention. Personnel of other trades, not engaged in asbestos abatement activities, shall not be exposed at any time to airborne concentrations of asbestos unless all the administrative and personal protective provisions of the Contractor's Accident Prevention Plan are complied with. Power to the regulated area shall be locked-out and tagged in accordance with 29 CFR 1910, and temporary electrical service with ground fault circuit interrupters shall be provided as needed. Temporary electrical service shall be disconnected when necessary for wet removal. The Contractor shall stop abatement work in the regulated area immediately when the airborne total fiber concentration: (1) equals or exceeds 0.01 f/cc, or the pre-abatement concentration, whichever is greater, outside the regulated area; or (2) equals or exceeds 1.0 f/cc inside the regulated area. The Contractor shall correct the condition to the satisfaction of the Contracting Officer, including visual inspection and air sampling. Work shall resume only upon notification by the Contracting Officer. Corrective actions shall be documented.

### 3.2 PROTECTION OF ADJACENT WORK OR AREAS TO REMAIN

Asbestos abatement shall be performed without damage to or contamination of adjacent work or area. Where such work or area is damaged or contaminated, as verified by the Contracting Officer using visual inspection or sample analysis, it shall be restored to its original condition or decontaminated by the Contractor at no expense to the Government, as deemed appropriate by the Contracting Officer. This includes inadvertent spill of dirt, dust or debris in which it is reasonable to conclude that asbestos may exist. When these spills occur, work shall stop in all effected areas immediately and the spill shall be cleaned. When satisfactory visual inspection and air sampling analysis results are obtained and have been evaluated by the Contractor's Designated IH and the Contracting Officer, work shall proceed.

### 3.3 OBJECTS

#### 3.3.1 Removal of Mobile Objects

Mobile objects, furniture, and equipment will be removed from the area of work by the Government before asbestos abatement work begins. These objects shall be removed to an area or site designated on DETAIL SHEET 27 and as identified by the Contracting Officer, and stored; or other appropriate action taken as identified on DETAIL SHEET 27. Carpets, draperies, and other items which may not be suitable for onsite wet cleaning methods shall be properly laundered in accordance with 29 CFR 1926, Section .1101 or disposed of as asbestos contaminated material.

#### 3.3.2 Stationary Objects

Stationary objects, furniture, and equipment as shown on DETAIL SHEET 27, shall remain in place and shall be precleaned using HEPA vacuum followed by adequate wet wiping. Stationary objects and furnishings shall be covered with 2 layers of polyethylene and edges sealed with duct tape.

#### 3.3.3 Reinstallation of Mobile Objects

At the conclusion of the asbestos abatement work in each regulated area, and after meeting the final clearance requirements for each regulated area, objects previously removed shall be transferred back to the cleaned area from which they came in accordance with the storage code designation for that material as shown on DETAIL SHEET 27, and reinstalled.

### 3.4 BUILDING VENTILATION SYSTEM AND CRITICAL BARRIERS

Building ventilating systems supplying air into or returning air out of a regulated area shall be shut down and isolated by lockable switch or other positive means in accordance with 29 CFR 1910, Section .147 or isolated by airtight seals to prevent the spread of contamination throughout the system. Air-tight critical barriers shall be installed on building ventilating openings located inside the regulated area that supply or return air from the building ventilation system or serve to exhaust air from the building. The critical barriers shall consist of air-tight rigid covers for building ventilation supply and exhaust grills where the

ventilation system is required to remain in service during abatement] 2 layers of polyethylene. Edges to wall, ceiling and floor surfaces shall be sealed with industrial grade duct tape. Critical barriers shall be installed as shown on drawings and appended SET-UP DETAIL SHEETS.

### 3.5 PRECLEANING

Surfaces shall be cleaned by HEPA vacuum and adequately wet wiped prior to establishment of containment at the discretion of the Contracting Officer.

### 3.6 METHODS OF COMPLIANCE

#### 3.6.1 Mandated Practices

The Contractor shall employ proper handling procedures in accordance with 29 CFR 1926 and 40 CFR 61, Subpart M, and the specified requirements. The specific abatement techniques and items identified shall be detailed in the Contractor's Asbestos Hazard Abatement Plan including, but not limited to, details of construction materials, equipment, and handling procedures. The Contractor shall use the following engineering controls and work practices in all operations, regardless of the levels of exposure:

- a. Vacuum cleaners equipped with HEPA filters to collect debris and dust containing ACM.
- b. Wet methods or wetting agents to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup; except where it can be demonstrated that the use of wet methods is unfeasible due to, for example, the creation of electrical hazards, equipment malfunction, and in roofing.
- c. Prompt clean-up and disposal in leak-tight containers of wastes and debris contaminated with asbestos.
- d. Inspection and repair of polyethylene in work and high traffic areas.
- e. Cleaning of equipment and surfaces of containers filled with ACM prior to removing them from the equipment room or area.

#### 3.6.2 Control Methods

The Contractor shall use the following control methods to comply with the PELs:

- a. Local exhaust ventilation equipped with HEPA filter dust collection systems;
- b. Enclosure or isolation of processes producing asbestos dust;
- c. Ventilation of the regulated area to move contaminated air away from the breathing zone of employees and toward a filtration or collection device equipped with a HEPA filter;

- d. Use of other work practices and engineering controls;
- e. Where the feasible engineering and work practice controls described above are not sufficient to reduce employee exposure to or below the PELs, the Contractor shall use them to reduce employee exposure to the lowest levels attainable by these controls and shall supplement them by the use of respiratory protection that complies with paragraph, RESPIRATORY PROTECTION PROGRAM.

### 3.6.3 Unacceptable Practices

The following work practices and engineering controls shall not be used for work related to asbestos or for work which disturbs ACM, regardless of measured levels of asbestos exposure or the results of initial exposure assessments:

- a. High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filtered exhaust air.
- b. Compressed air used to remove asbestos, or materials containing asbestos, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.
- c. Dry sweeping, shoveling, or other dry clean-up of dust and debris containing ACM.
- d. Employee rotation as a means of reducing employee exposure to asbestos.

### 3.6.4 Class I Work Procedures

In addition to requirements of paragraphs Mandated Practices and Control Methods, the following engineering controls and work practices shall be used:

- a. A Competent Person shall supervise the installation and operation of the control system.
- b. For jobs involving the removal of more than 25 feet or 10 square feet of TSI or surfacing material, the Contractor shall place critical barriers over all openings to the regulated area.
- c. HVAC systems shall be isolated in the regulated area by sealing with a double layer of plastic or air-tight rigid covers.
- d. Impermeable dropcloths (6 mil or greater thickness) shall be placed on surfaces beneath all removal activity.
- e. Objects within the regulated area shall be handled as specified in paragraph OBJECTS.
- f. Where a negative exposure assessment has not been provided or

where exposure monitoring shows the PEL was exceeded, the regulated area shall be ventilated to move contaminated air away from the employee's breathing zone toward a HEPA unit or collection device.

### 3.6.5 Specific Control Methods for Class I Work

In addition to requirements of paragraph Class I Work Procedures, Class I asbestos work shall be performed using the control methods identified in the subparagraphs below.

#### 3.6.5.1 Negative Pressure Enclosure (NPE) System

The NPE system shall be as shown in SETUP DETAIL SHEET [2] [3] [4] [8]. The system shall provide at least 4 air changes per hour inside the containment. The local exhaust unit equipment shall be operated 24 hours per day until the containment is removed, and shall be leak-proof to the filter and equipped with HEPA filters. Air movement shall be directed away from the employees and toward a HEPA filtration device. The NPE shall be smoke tested for leaks at the beginning of each shift. Local exhaust equipment shall be sufficient to maintain a minimum pressure differential of minus 0.02 inch of water column relative to adjacent, unsealed areas. Pressure differential shall be monitored continuously, 24 hours per day, with an automatic manometric recording instrument. Pressure differential recordings shall be provided daily on the same day collected. Readings shall be reviewed by the Contractor's Designated Competent Person and IH prior to submittal. The Contracting Officer shall be notified immediately if the pressure differential falls below the prescribed minimum. The building ventilation system shall not be used as the local exhaust system for the regulated area. The local exhaust system shall terminate outdoors unless an alternate arrangement is allowed by the Contract Officer. All filters used shall be new at the beginning of the project and shall be periodically changed as necessary and disposed of as ACM waste.

#### 3.6.5.2 Glovebag Systems

Glovebag systems shall be as shown in SETUP DETAIL SHEET 10. The glovebag system shall be used to remove ACM from straight runs of piping and elbows and other connections. Glovebags shall be used without modification and shall be smoke-tested for leaks and any leaks sealed prior to use. Glovebags shall be installed to completely cover the circumference of pipe or other structures where the work is to be done. Glovebags shall be used only once and shall not be moved. Glovebags shall not be used on surfaces that have temperatures exceeding 150 degrees F. Prior to disposal, glovebags shall be collapsed by removing air within them using a HEPA vacuum. Before beginning the operation, loose and friable material adjacent to the glovebag operation shall be wrapped and sealed in 2 layers of plastic or otherwise rendered intact. At least 2 persons shall perform Class I glovebag removal. Asbestos regulated work areas shall be established as specified and shown on detailed drawings and plans for glovebag abatement. Designated boundary limits for the asbestos work shall be established with rope or other continuous barriers and all other requirements for asbestos control areas shall be maintained, including area signage and boundary warning tape as specified in SET-UP DETAIL SHEET 11.



- a. In addition to requirements for negative pressure glovebag systems above, the Contractor shall attach HEPA vacuum systems or other devices to the bag to prevent collapse during removal of ACM from straight runs of piping and elbows and other connections.
- b. The negative pressure glove boxes used to remove ACM from pipe runs shall be fitted with gloved apertures and a bagging outlet and constructed with rigid sides from metal or other material which can withstand the weight of the ACM and water used during removal. A negative pressure shall be created in the system using a HEPA filtration system. The box shall be smoke tested for leaks prior to each use.

#### 3.6.5.3 Mini-Enclosures

Single bulkhead containment, double bulkhead containment, or Mini-containment (small walk-in enclosure) as shown in SETUP DETAIL SHEET 5, 6, and 7 to accommodate no more than 2 persons, may be used if the disturbance or removal can be completely contained by the enclosure with the following specifications and work practices. The mini-enclosure shall be inspected for leaks and smoke tested before each use. Air movement shall be directed away from the employee's breathing zone within the mini-enclosure.

#### 3.6.5.4 Wrap and Cut Operation

Wrap and cut operations shall be as shown in SETUP DETAIL SHEET 9B and 10. Prior to cutting pipe, the asbestos-containing insulation shall be wrapped with polyethylene and securely sealed with duct tape to prevent asbestos becoming airborne as a result of the cutting process. The following steps shall be taken: install glovebag, strip back sections to be cut 6 inches from point of cut, and cut pipe into manageable sections.

#### 3.6.6 Class II Work

In addition to the requirements of paragraphs Mandated Practices and Control Methods, the following engineering controls and work practices shall be used:

- a. A Competent Person shall supervise the work.
- b. For indoor work, critical barriers shall be placed over all openings to the regulated area.
- c. Impermeable dropcloths shall be placed on surfaces beneath all removal activity.

#### 3.6.7 Specific Control Methods for Class II Work

In addition to requirements of paragraph Class II Work, Class II work shall be performed using the following methods:

#### 3.6.7.1 Vinyl and Asphalt Flooring Materials

When removing vinyl and asphalt flooring materials which contain ACM from a building in which ACM has not been verified, the Contractor shall use the following practices as shown in RESPONSE ACTION DETAIL SHEET [56] [57] [58] [59] [60] [61] [62] [63] [64]. Resilient sheeting shall be removed by adequately wet methods. Tiles shall be removed intact (if possible); wetting is not required when tiles are heated and removed intact. Flooring or its backing shall not be sanded. Scraping of residual adhesive and/or backing shall be performed using wet methods. Mechanical chipping is prohibited unless performed in a negative pressure enclosure. Dry sweeping is prohibited. The Contractor shall use vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) to clean floors.

#### 3.6.7.2 Roofing Material

When removing roofing materials which contain ACM as described in 29 CFR 1926, Section .1101(g)(8)(ii), the Contractor shall use the following practices as shown in RESPONSE ACTION DETAIL SHEET [74] [75]. Roofing material shall be removed in an intact state. Wet methods shall be used to remove roofing materials that are not intact, or that will be rendered not intact during removal, unless such wet methods are not feasible or will create safety hazards. When removing built-up roofs, with asbestos-containing roofing felts and an aggregate surface, using a power roof cutter, all dust resulting from the cutting operations shall be collected by a HEPA dust collector, or shall be HEPA vacuumed by vacuuming along the cut line. Asbestos-containing roofing material shall not be dropped or thrown to the ground, but shall be lowered to the ground via covered, dust-tight chute, crane, hoist or other method approved by the Contracting Officer. Any ACM that is not intact shall be lowered to the ground as soon as practicable, but not later than the end of the work shift. While the material remains on the roof it shall be kept wet or placed in an impermeable waste bag or wrapped in plastic sheeting. Intact ACM shall be lowered to the ground as soon as practicable, but not later than the end of the work shift. Unwrapped material shall be transferred to a closed receptacle precluding the dispersion of dust. Critical barriers shall be placed over roof level heating and ventilation air intakes.

#### 3.6.7.3 Cementitious Siding and Shingles or Transite Panels

When removing cementitious asbestos-containing siding, shingles or transite panels the Contractor shall use the following practices shown in RESPONSE ACTION DETAIL SHEET [81] [82] [83]. Intentionally cutting, abrading or breaking siding, shingles, or transite panels is prohibited. Each panel or shingle shall be sprayed with amended water prior to removal. Nails shall be cut with flat, sharp instruments. Unwrapped or unbagged panels or shingles shall be immediately lowered to the ground via covered dust-tight chute, crane or hoist, or placed in an impervious waste bag or wrapped in plastic sheeting and lowered to the ground no later than the end of the work shift.

## 3.6.7.4 Gaskets

Gaskets shall be thoroughly wetted with amended water prior to removal and immediately placed in a disposal container. If a gasket is visibly deteriorated and unlikely to be removed intact, removal shall be undertaken within a glovebag. Any scraping to remove residue shall be performed wet.

## 3.6.7.5 Other Class II Jobs

The Contractor shall use the following work practices when performing Class II removal of ACM: The material shall be thoroughly wetted with amended water prior and during its removal. The material shall be removed in an intact state. Cutting, abrading or breaking the material is prohibited. The ACM removed shall be immediately bagged or wrapped.

## 3.6.8 Specific Control Methods for Class III Work

Class III asbestos work shall be conducted using engineering and work practice controls which minimize the exposure to employees performing the asbestos work and to bystander employees. The work shall be performed using wet methods and, to the extent feasible, using local exhaust ventilation. The Contractor shall use impermeable dropcloths and shall isolate the operation, using mini-enclosures or glovebag systems, where the disturbance involves drilling, cutting, abrading, sanding, chipping, breaking, or sawing of TSI or surfacing material.

## 3.6.9 Specific Control Methods for Class IV Work

Class IV jobs shall be conducted using wet methods, HEPA vacuums, and prompt clean-up of debris containing ACM. Employees cleaning up debris and waste in a regulated area where respirators are required shall wear the selected respirators.

## 3.6.10 Alternative Methods for Roofing Materials and Asphaltic Wrap

The Contractor shall use the following engineering controls and work practices when removing, repairing, or maintaining intact pipeline asphaltic wrap, or roof cements, mastics, coatings, or flashings which contain asbestos fibers encapsulated or coated by bituminous or resinous compounds. If during the course of the job the material does not remain intact, the Contractor shall use the procedures described in paragraph Roofing Material. Before work begins, and as needed during the job, the Designated Competent Person shall conduct an inspection and determine that the roofing material is intact and will likely remain intact. The material shall not be sanded, abraded, or ground. Manual methods which would render the material non-intact shall not be used. Roofing material shall not be dropped or thrown to the ground but shall be lowered via covered, dust-tight chute, crane, hoist or other method approved by the Contracting Officer. All such material shall be removed from the roof as soon as practicable, but not later than the end of the work shift. Removal or disturbance of pipeline asphaltic wrap shall be performed using wet methods.

## 3.6.11 Cleaning After Asbestos Removal

After completion of all asbestos removal work, surfaces from which ACM has been removed shall be wet wiped or sponged clean, or cleaned by some equivalent method to remove all visible residue. Run-off water shall be collected and filtered through a dual filtration system. A first filter shall be provided to remove fibers 20 micrometers and larger, and a final filter provided that removes fibers 5 micrometers and larger. After the gross amounts of asbestos have been removed from every surface, remaining visible accumulations of asbestos on floors shall be collected using plastic shovels, rubber squeegees, rubber dustpans, and HEPA vacuum cleaners as appropriate to maintain the integrity of the regulated area. When TSI and surfacing material has been removed, workmen shall use HEPA vacuum cleaners to vacuum every surface. Surfaces or locations which could harbor accumulations or residual asbestos dust shall be checked after vacuuming to verify that no asbestos-containing material remains; and shall be re-vacuumed as necessary to remove the ACM.

## 3.6.12 Class I Asbestos Work Response Action Detail Sheets

The following Class I Asbestos Work Response Action Detail Sheet is specified on Table 1 for each individual work task to be performed:

- a. Troweled Wall Plaster on Masonry: See Sheet 32
- b. Troweled Wall Plaster on Stud Wall: See Sheet 33
- c. Troweled Ceiling Plaster on Structural Substrate: See Sheet 35
- d. Troweled Ceiling Plaster on Hung Ceiling: See Sheet 36
- e. Acoustical Wall Plaster on Masonry: See Sheet 42
- f. Acoustical Ceiling Plaster (Non-Asbestos Substrate): See Sheet 44
- g. Asbestos Decorative Paint on Plaster: See Sheet 46
- h. Asbestos-contaminated Masonry for Masonry Chimney: See Sheet 50
- i. Asbestos-contaminated Masonry Wall or Thermal Insulation: See Sheet 51
- j. Fireproofing or Thermal Surface Insulation: See Sheet 68
- k. Acoustical Ceiling Insulation: See Sheet 70
- l. Exterior Asbestos Stucco: See Sheet 79
- m. Duct Insulation: Duct work insulation removal shall not begin without the written authorization of the Contracting Officer stating that the HVAC system to be worked on is either isolated or inoperative and locked out of service. Forced air circulation is not permitted in ductwork while abatement work is in progress. See Sheet 101

- n. Pipe Insulation (Using a Glovebag): See Sheet 87
- o. Horizontal Pipe Insulation (Using a Containment Area): See Sheet 88
- p. Pipe Insulation (Using a Mini-Containment Area): See Sheet 89
- q. Storage Tank and Boiler Breeching Insulation: See Sheet 93.  
Written approval shall be obtained from the Contracting Officer before start of work on tanks and boiler breeching. The Contracting Officer will ensure that tanks and boilers have been valved off or shut down and allowed a sufficient amount of time to cool down. Insulation shall be sprayed with a mist of amended water or removal encapsulant. Amended water or removal encapsulant shall be allowed to saturate material to substrate. Bands or wires holding breeching or insulation to equipment shall be cut. Cover jackets shall be slit at seams, and sections removed and hand-placed in a polyethylene disposable bag. Exposed surfaces shall be continuously sprayed with amended water to minimize airborne dust. Insulation on tanks and boiler breeching shall not be allowed to drop to the floor. Residue shall be removed from tank and boiler surfaces. A water stream shall be used to dislodge insulation in joints or irregular spaces that cannot be reached with tools. Lagging on piping and insulation on fittings shall be removed. A penetrating encapsulant shall be sprayed on all exposed tank, boiler and boiler breeching surfaces.
- r. Troweled Wall Plaster on Studs: See Sheet 30
- s. Troweled Ceiling or Wall Plaster on Masonry: See Sheet 31
- t. Acoustical Ceiling on Wall Plaster: See Sheet 41
- u. Interior Stucco: See Sheet 78
- v. Exterior Stucco: See Sheet 80
- w. Pipe and Fitting Insulation (using Glovebag): See Sheet 86
- x. Storage Tank and Boiler Breeching: See Sheet 92
- y. Duct Insulation: See Sheet 100.

### 3.6.13 Class II Asbestos Work Response Action Detail Sheets

The following Class II Asbestos Work Response Action Detail Sheet is specified on Table 1 for each individual work task to be performed:

- a. Light Curtain: See Sheet 47
- b. Interior Asbestos Cement, Fiberboard and Drywall Panels: See Sheet 48

- c. Suspended Asbestos Cement Ceiling Tile: See Sheet 52
- d. Asbestos Cement Architectural Products: See Sheet 53
- e. Glued-on Acoustical Ceiling and Wall Tile: See Sheet 55
- f. Suspended Acoustical Ceiling Tile: See Sheet 54
- g. Vinyl or Vinyl Asbestos Tile Adhered to Concrete Floor System by Asbestos-Containing Adhesive: See Sheet 56
- h. Vinyl or Vinyl Asbestos Tile Adhered to Wood Floor System by Asbestos Containing Adhesive: See Sheet 60
- i. Vinyl Asbestos Tile Adhered to Concrete Floor System by Asbestos Containing Adhesive: See Sheet 57
- j. Vinyl Asbestos Tile Adhered to Concrete Floor System by Asbestos Free Adhesive: See Sheet 58
- k. Vinyl Asbestos Tile and Chemical Dissolution of Asbestos-Containing Adhesives on Concrete Floor System: See Sheet 59
- l. Vinyl Asbestos Tile Adhered to Wood Floor System by Asbestos-Containing Adhesive: See Sheet 61
- m. Vinyl Asbestos Tile Adhered to Wood Floor System by Asbestos Free Adhesive: See Sheet 62
- n. Sheet Flooring Adhered Wood Floor System: See Sheet 63
- o. Asbestos-Containing Sheet Flooring Adhered to Concrete Floor System by Asbestos-Containing Adhesive: See Sheet 64
- p. Carpeting (Asbestos-Containing or Contaminated): See Sheet 65
- q. Miscellaneous Asbestos-Containing Materials: See Sheet 45
- r. Built-Up Roofing and Flashing: See Sheet 74
- s. Roof, Shingles and Underlayment: See Sheet 75
- t. Asbestos Cement Siding: See Sheet 81
- u. Asbestos Cement Roofing: See Sheet 82
- v. Asbestos-Containing Walkway Cover: See Sheet 83
- w. Asbestos-Contaminated Metal Siding: See Sheet 84
- x. Asbestos Cement Sunscreen Louvers: See Sheet 85
- y. Electrical Wiring and Fixtures: See Sheet 95

z. Asbestos Insulated Electrical Fixture: See Sheet 96

aa. Boiler Firebox Insulation: The asbestos-containing boiler firebox lining shall be removed from out-of-service boilers before the boiler is dismantled: See Sheet 97.

#### 3.6.14 Abatement of Asbestos Contaminated Soil

Asbestos contaminated soil shall be removed from areas to a minimum depth of 2 inches. Soil shall be thoroughly dampened with amended water and then removed by manual shoveling into labeled containers. The workers shall be closely monitored for heat exhaustion. The minimum ventilation shall be 8 air changes per hour through a local exhaust HEPA system. See DETAIL SHEET 73. The Contractor has the option to propose encapsulation of soil instead of removal. Since soil encapsulation is highly dependent on soil chemistry, available skills for application and proprietary products, the Contractor shall first test the proposed soil encapsulant on a minimum 100 square feet of soil area onsite. The test shall be witnessed by the Contracting Officer's and the manufacturer's representative. A written application for encapsulation shall be submitted to the Contracting Officer with test results, encapsulant manufacturer's positive recommendation for use, a guarantee for satisfactory performance for 10 years, and limitation of application. The Contracting Officer reserves the right to accept or reject the application with no effect to the contract. If the application is accepted, the soil encapsulation shall proceed in compliance with all provisions and instructions of the encapsulant manufacturer and under the supervision of a person certified by the manufacturer who is trained and experienced in the proper application of the soil encapsulant. See DETAIL SHEET 72. A concrete slab of minimum 2 inch thickness shall be poured over the entire soil surface. Soil surface shall be thoroughly dampened before pouring concrete. Soil encapsulators and supervisors shall be primarily concrete workers trained to work in asbestos contaminated environments. See DETAIL SHEET 71.

#### 3.6.15 Enclosure of ACM

Isolation of ACM by construction of a permanent enclosure shall not be conducted.

#### 3.6.16 Encapsulation of ACM

Prior to applying any encapsulant, the entire surface area shall be inspected for loose, or damaged asbestos material:

a. Penetrating Encapsulation: Before penetrating encapsulation is applied, asbestos removal work in the area shall be complete and the surfaces to be encapsulated shall be free of loose or damaged material. Substrate shall be evaluated before application to ensure that the encapsulant will not cause the substrate to fail in any way. Acoustical wall and ceiling plaster surfaces shall be encapsulated in accordance with manufacturer's recommendations. Plug samples shall be taken to determine if full penetration has been achieved. If full penetration has not been achieved,

surfaces shall be recoated while the matrix is still wet, until full penetration is achieved: See Detail Sheet 39.

- b. Bridging Encapsulation: Prior to applying the bridging encapsulant, the pre-encapsulation inspection shall be performed. The surface shall be encapsulated in sections of 1000 square feet or less as recommended by the encapsulant manufacturer. Upon completion of each section, the dry thickness of the bridging encapsulation shall be measured. Additional bridging encapsulant shall be applied to obtain the desired encapsulant thickness. Additional coats shall blend with the original bridging encapsulant. Bridging encapsulation shall include:

- (1) Troweled Wall Plaster: See Detail Sheet 29
- (2) Troweled Ceiling Plaster: See Detail Sheet 34
- (3) Acoustical Wall Plaster: See Detail Sheet 38
- (4) Acoustical Ceiling Plaster: See Detail Sheet 34
- (5) Asbestos Cement Wall, Fiberboard and Drywall Panels: See Detail Sheet 49
- (6) Exterior Asbestos Stucco: See Detail Sheet 76
- (7) Interior Asbestos Stucco: See Detail Sheet 77
- (8) Storage Tank and Boiler Breeching: See Detail Sheet 91
- (9) Boiler and Piping Gasket: See Detail Sheet 98.

#### 3.6.17 Combination Encapsulation of Acoustical Wall and Ceiling Plaster

The combination penetrating/bridging encapsulation system shall be installed by first applying the penetrating encapsulant and then the bridging encapsulant: See Detail Sheet 40.

#### 3.6.18 Response Action Detail Sheets for Repair of Class I Materials

- a. Troweled Wall Plaster on Studs: See Detail Sheet 30
- b. Troweled Ceiling or Wall Plaster on Masonry: See Detail Sheet 31
- c. Acoustical Ceiling on Wall Plaster: See Detail Sheet 41
- d. Interior Stucco: See Detail Sheet 78
- e. Exterior Stucco: See Detail Sheet 80
- f. Pipe and Fitting Insulation (using Glovebag): See Detail Sheet 86
- g. Storage Tank and Boiler Breeching: See Detail Sheet 92
- h. Duct Insulation: See Detail Sheet 100
- i. Exposed Pipe Insulation Edges: Asbestos insulation to remain shall have exposed edges contained; the following steps shall be performed: Wet and cut the rough ends true and square with sharp tools and then encapsulate the edges with a 1/4 inch thick layer of non-asbestos-containing insulating cement troweled to a smooth hard finish; when cement is dry, lag the end with a layer of



non-asbestos lagging cloth, overlapping the existing ends by 4 inches.

#### 3.6.19 Response Action Detail Sheets for Repair of Class II Materials

- a. Vinyl or Vinyl Asbestos Tile Adhered to Concrete Floor System by Asbestos-Containing Adhesive: See Detail Sheet 56
- b. Vinyl or Vinyl Asbestos Tile Adhered to Wood Floor System by Asbestos Containing Adhesive: See Detail Sheet 60.

#### 3.6.20 Encasement of ACM

Prior to applying the first layer of the polymer system, the structural stability of the ACM shall be verified. Encasement materials shall not be applied until all removal work within the regulated area has been completed. Mechanical fasteners shall be installed to wall, mesh or deck as needed. A low density cellular or polymer shall be applied to a depth of approximately 1 inch. The asbestos substrate shall be completely encased. A polymer finish containing fiberglass shall be applied over the low density cellular foam to a thickness of 1 inch. All system components shall be applied according to the system manufacturer's instructions and data. Encased material shall be decontaminated. Encasement shall be applied to:

- a. Beams and Decking: See Detail Sheet 66
- b. Columns: See Detail Sheet 67
- c. Acoustical Ceiling Insulation: See Detail Sheet 69
- d. Storage Tank and Boiler Breeching: See Detail Sheet 90.

#### 3.6.21 Sealing Contaminated Items Designated for Disposal

Contaminated architectural, mechanical, and electrical appurtenances such as Venetian blinds, full height partitions, carpeting, duct work, pipes and fittings, radiators, light fixtures, conduit panels, and other contaminated items designated for removal shall be coated with an asbestos lockdown encapsulant at the demolition site before being removed from the asbestos control area. These items shall be vacuumed prior to application of the lockdown encapsulant. The asbestos lockdown encapsulant shall be tinted a contrasting color and shall be spray applied by airless method. Thoroughness of sealing operation shall be visually gauged by the extent of colored coating on exposed surfaces.

#### 3.7 FINAL CLEANING AND VISUAL INSPECTION

Upon completion of abatement, the regulated area shall be cleaned by collecting, packing, and storing all gross contamination; see SET-UP DETAIL SHEETS 9, 14 and 20. A final cleaning shall be performed using HEPA vacuum and wet cleaning of all exposed surfaces and objects in the regulated area. Upon completion of the cleaning, the Contractor shall conduct a visual pre-inspection of the cleaned area in preparation for a final inspection

before final air clearance monitoring and recleaning, as necessary. Upon completion of the final cleaning, the Contractor and the Contracting Officer shall conduct a final visual inspection of the cleaned regulated area in accordance with ASTM E 1368 and document the results on the Final Cleaning and Visual Inspection as specified on the SET-UP DETAIL SHEET 19. If the Contracting Officer rejects the clean regulated area as not meeting final cleaning requirements, the Contractor shall reclean as necessary and have a follow-on inspection conducted with the Contracting Officer. Recleaning and follow-up reinspection shall be at the Contractor's expense.

### 3.8 LOCKDOWN

Prior to removal of plastic barriers and after clean-up of gross contamination and final visual inspection, a post removal (lockdown) encapsulant shall be spray applied to ceiling, walls, floors, and other surfaces in the regulated area.

### 3.9 EXPOSURE ASSESSMENT AND AIR MONITORING

#### 3.9.1 General Requirements For Exposure

Exposure assessment, air monitoring and analysis of airborne concentration of asbestos fibers shall be performed in accordance with 29 CFR 1926, Section .1101, the Contractor's air monitoring plan, and as specified. Personal exposure air monitoring (collected at the breathing zone) that is representative of the exposure of each employee who is assigned to work within a regulated area shall be performed by the Contractor's Designated IH.

Breathing zone samples shall be taken for at least 25 percent of the workers in each shift, or a minimum of 2, whichever is greater. Air monitoring results at the 95 percent confidence level shall be calculated as shown in Table 2 at the end of this section. The Contracting Officer will provide an onsite independent testing laboratory with qualified analysts and appropriate equipment to conduct sample analyses of air samples using the methods prescribed in 29 CFR 1926, Section .1101, to include NIOSH 84-100 Method 7400. Preabatement and abatement environmental air monitoring shall be performed by the Contractor's Designated IH and Contracting Officer's IH. Final clearance environmental air monitoring, shall be performed by the Contracting Officer's IH. Environmental and final clearance air monitoring shall be performed using NIOSH 84-100 Method 7400 (PCM) with optional confirmation of results by NIOSH 84-100 Method 7402 (TEM) or the EPA TEM Method specified in 40 CFR 763. For environmental and final clearance, air monitoring shall be conducted at a sufficient velocity and duration to establish the limit of detection of the method used at 0.005 f/cc. Confirmation of asbestos fiber concentrations (asbestos f/cc) from environmental and final clearance samples collected and analyzed by NIOSH 84-100 Method 7400 (total f/cc) may be conducted using TEM in accordance with NIOSH 84-100 Method 7402. When such confirmation is conducted, it shall be from the same sample filter used for the NIOSH 84-100 Method 7400 PCM analysis. For all Contractor required environmental or final clearance air monitoring, confirmation of asbestos fiber concentrations, using NIOSH 84-100 Method 7402, shall be at the Contractor's expense. Monitoring may be duplicated by the Government at the discretion of the Contracting Officer. Results of breathing zone samples shall be posted at the job site and made available to the

Contracting Officer. The Contractor shall maintain a fiber concentration inside a regulated area less than or equal to 0.1 f/cc expressed as an 8 hour, time-weighted average (TWA) during the conduct of the asbestos abatement. If fiber concentration rises above 0.1 f/cc, work procedures shall be investigated with the Contracting Officer to determine the cause. At the discretion of the Contracting Officer, fiber concentration may exceed 0.1 f/cc but shall not exceed 1.0 f/cc expressed as an 8-hour TWA. The Contractor's workers shall not be exposed to an airborne fiber concentration in excess of 1.0 f/cc, as averaged over a sampling period of 30 minutes. Should either an environmental concentration of 1.0 f/cc expressed as an 8-hour TWA or a personal excursion concentration of 1.0 f/cc expressed as a 30-minute sample occur inside a regulated work area, the Contractor shall stop work immediately, notify the Contracting Officer, and implement additional engineering controls and work practice controls to reduce airborne fiber levels below prescribed limits in the work area. Work shall not restart until authorized by the Contracting Officer.

### 3.9.2 Initial Exposure Assessment

The Contractor's Designated IH shall conduct an exposure assessment immediately before or at the initiation of an asbestos abatement operation to ascertain expected exposures during that operation. The assessment shall be completed in time to comply with the requirements which are triggered by exposure data or the lack of a negative exposure assessment, and to provide information necessary to assure that all control systems planned are appropriate for that operation. The assessment shall take into consideration both the monitoring results and all observations, information or calculations which indicate employee exposure to asbestos, including any previous monitoring conducted in the workplace, or of the operations of the Contractor which indicate the levels of airborne asbestos likely to be encountered on the job. For Class I asbestos work, until the employer conducts exposure monitoring and documents that employees on that job will not be exposed in excess of PELs, or otherwise makes a negative exposure assessment, the Contractor shall presume that employees are exposed in excess of the PEL-TWA and PEL-Excursion Limit.

### 3.9.3 Negative Exposure Assessment

The Contractor shall provide a negative exposure assessment for the specific asbestos job which will be performed. The negative exposure assessment shall be provided within 3 days of the initiation of the project and conform to the following criteria:

- a. Objective Data: Objective data demonstrating that the product or material containing asbestos minerals or the activity involving such product or material cannot release airborne fibers in concentrations exceeding the PEL-TWA and PEL-Excursion Limit under those work conditions having the greatest potential for releasing asbestos.
- b. Prior Asbestos Jobs: Where the Contractor has monitored prior asbestos jobs for the PEL and the PEL-Excursion Limit within 12 months of the current job, the monitoring and analysis were performed in compliance with asbestos standard in effect; the data

were obtained during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the Contractor's current operations; the operations were conducted by employees whose training and experience are no more extensive than that of employees performing the current job; and these data show that under the conditions prevailing and which will prevail in the current workplace, there is a high degree of certainty that the monitoring covered exposure from employee exposures will not exceed the PEL-TWA and PEL-Excursion Limit.

- c. Initial Exposure Monitoring: The results of initial exposure monitoring of the current job, made from breathing zone air samples that are representative of the 8-hour PEL-TWA and 30-minute short-term exposures of each employee. The monitoring covered exposure from operations which are most likely during the performance of the entire asbestos job to result in exposures over the PELs.

#### 3.9.4 Independent Environmental Monitoring

The Government will retain an independent air monitoring firm to perform pre-abatement, during abatement and final clearance air monitoring. The air monitoring contractor has been provided a copy of the contract that includes this abatement work. The abatement contractor will provide the air monitoring contractor with an up-to-date copy of the accepted Asbestos Hazard Abatement Plan, Accident Prevention Plan and pertinent detailed drawings. The air monitoring contractor is required to comply with the abatement contractor's safety and health requirements. The abatement contractor will coordinate all onsite activities with the air monitoring contractor, the COR, and other affected parties as directed by the COR. The abatement contractor will provide the air monitoring contractor with an up-to-date schedule of abatement contractor work activities. The air monitoring contractor will coordinate with the abatement contractor and the COR during the performance Government required air monitoring. The abatement contractor is responsible for performing exposure assessment and personal air monitoring of abatement contractor's work. The air monitoring contractor is responsible for performing these tasks for its employee.

#### 3.9.5 Preabatement Environmental Air Monitoring

Preabatement environmental air monitoring shall be established 1 day prior to the masking and sealing operations for each regulated area to determine background concentrations before abatement work begins. As a minimum, preabatement air samples shall be collected using NIOSH 84-100 Method 7400, PCM at these locations: outside the building; inside the building, but outside the regulated area perimeter; and inside each regulated work area. One sample shall be collected for every 2000 square feet of floor space. At least 2 samples shall be collected outside the building: at the exhaust of the HEPA unit; and downwind from the abatement site. The PCM samples shall be analyzed within 24 hours; and if any result in fiber concentration greater than 0.01 f/cc, asbestos fiber concentration shall be confirmed using NIOSH 84-100 Method 7402 (TEM).

### 3.9.6 Environmental Air Monitoring During Abatement

Until an exposure assessment is provided to the Contracting Officer, environmental air monitoring shall be conducted at locations and frequencies that will accurately characterize any evolving airborne asbestos fiber concentrations. The assessment shall demonstrate that the product or material containing asbestos minerals, or the abatement involving such product or material, cannot release airborne asbestos fibers in concentrations exceeding 0.01 f/cc as a TWA under those work conditions having the greatest potential for releasing asbestos. The monitoring shall be at least once per shift at locations including, but not limited to, close to the work inside a regulated area; preabatement sampling locations; outside entrances to a regulated area; close to glovebag operations; representative locations outside of the perimeter of a regulated area; inside clean room; and at the exhaust discharge point of local exhaust system ducted to the outside of a containment (if used). If the sampling outside regulated area shows airborne fiber levels have exceeded background or 0.01 f/cc, whichever is greater, work shall be stopped immediately, and the Contracting Officer notified. The condition causing the increase shall be corrected. Work shall not restart until authorized by the Contracting Officer.

### 3.9.7 Final Clearance Air Monitoring

Prior to conducting final clearance air monitoring, the Contractor and the Contracting Officer shall conduct a final visual inspection of the regulated area where asbestos abatement has been completed. The final visual inspection shall be as specified in SET-UP DETAIL SHEET 19. Final clearance air monitoring shall not begin until acceptance of the Contractor's final cleaning by the Contracting Officer. The Contracting Officer's IH will conduct final clearance air monitoring using aggressive air sampling techniques as defined in EPA 560/5-85-024 or as otherwise required by federal or state requirements. The sampling and analytical method used will be [NIOSH 84-100 Method 7400 (PCM) and Table 3 with confirmation of results by NIOSH 84-100 Method 7402 (TEM) or the EPA TEM Method specified at 40 CFR 763 and Table 4.]

#### 3.9.7.1 Final Clearance Requirements, NIOSH PCM Method

For PCM sampling and analysis using NIOSH 84-100 Method 7400, the fiber concentration inside the abated regulated area, for each airborne sample, shall be less than 0.01 f/cc. The abatement inside the regulated area is considered complete when every PCM final clearance sample is below the clearance limit. If any sample result is greater than 0.01 total f/cc, the asbestos fiber concentration (asbestos f/cc) shall be confirmed from that same filter using NIOSH 84-100 Method 7402 (TEM) at Contractor's expense. If any confirmation sample result is greater than 0.01 asbestos f/cc, abatement is incomplete and cleaning shall be repeated. Upon completion of any required recleaning, resampling with results to meet the above clearance criteria shall be done.

## 3.9.7.2 Final Clearance Requirements, EPA TEM Method

For EPA TEM sampling and analysis, using the EPA Method specified in 40 CFR 763, abatement inside the regulated area is considered complete when the arithmetic mean asbestos concentration of the 5 inside samples is less than or equal to 70 structures per square millimeter (70 S/mm). When the arithmetic mean is greater than 70 S/mm, the 3 blank samples shall be analyzed. If the 3 blank samples are greater than 70 S/mm, resampling shall be done. If less than 70 S/mm, the 5 outside samples shall be analyzed and a Z-test analysis performed. When the Z-test results are less than 1.65, the decontamination shall be considered complete. If the Z-test results are more than 1.65, the abatement is incomplete and cleaning shall be repeated. Upon completion of any required recleaning, resampling with results to meet the above clearance criteria shall be done.

## 3.9.7.3 Air Clearance Failure

If clearance sampling results fail to meet the final clearance requirements, the Contractor shall pay all costs associated with the required recleaning, resampling, and analysis, until final clearance requirements are met.

## 3.9.8 Air-Monitoring Results and Documentation

Air sample fiber counting shall be completed and results provided within 24 hours (breathing zone samples), and 24 hours (environmental/clearance monitoring) after completion of a sampling period. The Contracting Officer shall be notified immediately of any airborne levels of asbestos fibers in excess of established requirements. Written sampling results shall be provided within 5 working days of the date of collection. The written results shall be signed by testing laboratory analyst, testing laboratory principal and the Contracting Officer's IH. The air sampling results shall be documented on a Contractor's daily air monitoring log. The daily air monitoring log shall contain the following information for each sample:

- a. Sampling and analytical method used;
- b. Date sample collected;
- c. Sample number;
- d. Sample type: BZ = Breathing Zone (Personal), P = Preabatement, E = Environmental, C = Abatement Clearance;
- e. Location/activity/name where sample collected;
- f. Sampling pump manufacturer, model and serial number, beginning flow rate, end flow rate, average flow rate (L/min);
- g. Calibration date, time, method, location, name of calibrator, signature;
- h. Sample period (start time, stop time, elapsed time (minutes);

- i. Total air volume sampled (liters);
- j. Sample results (f/cc and S/mm square) if EPA methods are required for final clearance;
- k. Laboratory name, location, analytical method, analyst, confidence level. In addition, the printed name and a signature and date block for the Industrial Hygienist who conducted the sampling and for the Industrial Hygienist who reviewed the daily air monitoring log verifying the accuracy of the information.

### 3.10 CLEARANCE CERTIFICATION

When asbestos abatement is complete, ACM waste is removed from the regulated areas, and final clean-up is completed, the Contracting Officer will certify the areas as safe before allowing the warning signs and boundary warning tape to be removed. After final clean-up and acceptable airborne concentrations are attained, but before the HEPA unit is turned off and the containment removed, the Contractor shall remove all pre-filters on the building HVAC system and provide new pre-filters. The Contractor shall dispose of such filters as asbestos contaminated materials. HVAC, mechanical, and electrical systems shall be re-established in proper working order. The Contractor and the Contracting Officer shall visually inspect all surfaces within the containment for residual material or accumulated debris. The Contractor shall reclean all areas showing dust or residual materials. The Contracting Officer will certify in writing that the area is safe before unrestricted entry is permitted. The Government will have the option to perform monitoring to certify the areas are safe before entry is permitted.

### 3.11 CLEANUP AND DISPOSAL

#### 3.11.1 Title to ACM Materials

ACM material resulting from abatement work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified and in accordance with applicable federal, state and local regulations.

#### 3.11.2 Collection and Disposal of Asbestos

All ACM waste shall be collected and including contaminated wastewater filters, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing, shall be collected and placed in leak-tight containers such as double plastic bags (see DETAIL SHEET 9A); sealed double wrapped polyethylene sheet (see DETAIL 9B); sealed fiberboard boxes (see DETAIL SHEET 9C); or other approved containers. Waste within the containers shall be wetted in case the container is breached. Asbestos-containing waste shall be disposed of at an EPA, Commonwealth of Virginia and local approved asbestos landfill off Government property. For temporary storage, sealed impermeable containers shall be stored in an asbestos waste load-out unit or in a storage/transportation conveyance (i.e., dumpster, roll-off waste boxes, etc.) in a manner acceptable to and in an area assigned by the Contracting Officer. Procedure for hauling and

disposal shall comply with 40 CFR 61, Subpart M, state, regional, and local standards.

#### 3.11.3 Scale Weight Measurement

Scales used for measurement shall be public scales. Weighing shall be at a point nearest the work at which a public scale is available. Scales shall be standard truck scales of the beam type; scales shall be equipped with the type registering beam and an "over and under" indicator; and shall be capable of accommodating the entire vehicle. Scales shall be tested, approved and sealed by an inspector of the Commonwealth of Virginia. Scales shall be calibrated and resealed as often as necessary and at least once every three months to ensure continuous accuracy. Vehicles used for hauling ACM shall be weighed empty daily at such time as directed and each vehicle shall bear a plainly legible identification mark.

#### 3.11.4 Weigh Bill and Delivery Tickets

Copies of weigh bills and delivery tickets shall be submitted to the Contracting Officer during the progress of the work. The Contractor shall furnish the Contracting Officer scale tickets for each load of ACM weighed and certified. These tickets shall include tare weight; identification mark for each vehicle weighed; and date, time and location of loading and unloading. Tickets shall be furnished at the point and time individual trucks arrive at the worksite. A master log of all vehicle loading shall be furnished for each day of loading operations. Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified weigh bills and/or certified tickets and manifests of all ACM actually disposed by the Contractor for this contract.

#### 3.11.5 Asbestos Waste Shipment Record

The Contractor shall complete and provide the Contracting Officer final completed copies of the Waste Shipment Record for all shipments of waste material as specified in 40 CFR 61, Subpart M and other required state waste manifest shipment records, within 3 days of delivery to the landfill.

Each Waste Shipment Record shall be signed and dated by the Contractor and Contracting Officer, the waste transporter and disposal facility operator.



TABLE 1

## INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet \_\_\_\_\_ of \_\_\_\_\_

There is a separate data sheet for each individual work task.

1. WORK TASK DESIGNATION NUMBER \_\_\_\_\_
2. LOCATION OF WORK TASK \_\_\_\_\_
3. BRIEF DESCRIPTION OF MATERIAL TO BE ABATED: \_\_\_\_\_
- a. Type of Asbestos \_\_\_\_\_
- b. Percent asbestos content \_\_\_\_\_%
4. ABATEMENT TECHNIQUE TO BE USED \_\_\_\_\_
5. OSHA ASBESTOS CLASS DESIGNATION FOR WORK TASK \_\_\_\_\_
6. EPA NESHAP FRIABILITY DESIGNATION FOR WORK TASK  
Friable \_\_\_\_\_ Non-friable Category I \_\_\_\_\_  
Non-friable Category II \_\_\_\_\_
7. FORM \_\_\_\_\_ and CONDITION OF ACM: GOOD \_\_\_\_\_ FAIR \_\_\_\_\_ POOR \_\_\_\_\_
8. QUANTITY: METERS \_\_\_\_\_, SQUARE METERS \_\_\_\_\_
- 8a. QUANTITY: LINEAR FT. \_\_\_\_\_, SQUARE FT. \_\_\_\_\_
9. RESPONSE ACTION DETAIL SHEET NUMBER FOR WORK TASK \_\_\_\_\_
10. SET-UP DETAIL SHEET NUMBERS  
FOR WORK TASK \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_,  
\_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_.

## NOTES:

- (1) Numeric sequence of individual work tasks (1,2,3,4, etc.) for each regulated area. Each category of EPA friability/OSHA class has a separate task.
- (2) Specific location of work (building, floor, area, e.g., Building 1421, 2nd Floor, Rm 201)
- (3) A description of material to be abated (example: horizontal pipe, cement wall panels, tile, stucco, etc.) type of asbestos (chrysotile, amosite, crocidolite, etc.); and % asbestos content.
- (4) Technique to be used: Removal = REM; Encapsulation = ENCAP; Encasement = ENCAS; Enclosure = ENCL; Repair = REP.
- (5) Class designation: Class I, II, III, or IV (OSHA designation).
- (6) Friability of materials: Check the applicable EPA NESHAP friability designation.
- (7) Form: Interior or Exterior Architectural = IA or EA; Mechanical/Electrical = ME.  
Condition: Good = G; Fair = F; Poor = P.
- (8) Quantity of ACM for each work task in meters or square meters.
- (8a) Quantity of ACM for each work task in linear feet or square feet.
- (9) Response Action Detail Sheet specifies the material to be abated and the methods to be used. There is only one Response Action Detail Sheet for each abatement task.
- (10) Set-up Detail Sheets indicate containment and control methods used

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS  
in support of the response action (referenced in the selected  
Response Action Detail Sheet).

TABLE 2

FORMULA FOR CALCULATION OF THE 95 PERCENT CONFIDENCE LEVEL  
(Reference: NIOSH 7400)

---

$$\text{Fibers/cc(01.95 percent CL)} = X + [(X) * (1.645) * (CV)]$$

$$\text{Where: } X = ((E)(AC))/((V)(1000))$$

$$E = ((F/Nf) - (B/Nb))/Af$$

CV = The precision value; 0.45 shall be used unless the analytical laboratory provides the Contracting Officer with documentation (Round Robin Program participation and results) that the laboratory's precision is better.

AC = Effective collection area of the filter in square millimeters

V = Air volume sampled in liters

E = Fiber density on the filter in fibers per square millimeter

F/Nf = Total fiber count per graticule field

B/Nb = Mean field blank count per graticule field

Af = Graticule field area in square millimeters

$$\text{TWA} = C1/T1 + C2/T2 = Cn/Tn$$

Where: C = Concentration of contaminant

T = Time sampled.

TABLE 3

## NIOSH METHOD 7400

## PCM ENVIRONMENTAL AIR SAMPLING PROTOCOL (NON-PERSONAL)

Sample Location	Minimum No. of Samples	Filter Pore Size (Note 1)	Min. Vol. (Note 2) (Liters)	Sampling Rate (liters/min.)
Inside Abatement Area	0.5/140 Square Meters (Notes 3 & 4)	0.45 microns	3850	2-16
Each Room in 1 Abatement Area Less than 140 Square meters		0.45 microns	3850	2-16
Field Blank	2	0.45 microns	0	0
Laboratory Blank	1	0.45 microns	0	0

## Notes:

1. Type of filter is Mixed Cellulose Ester.
2. Ensure detection limit for PCM analysis is established at 0.005 fibers/cc.
3. One sample shall be added for each additional 140 square meters. (The corresponding I-P units are 5/1500 square feet).
4. A minimum of 5 samples are to be taken per abatement area, plus 2 field blanks.

TABLE 4

EPA AHERA METHOD: TEM AIR SAMPLING PROTOCOL

Location Sampled	Minimum No. of Samples	Filter Pore Size	Min. Vol. (Liters)	Sampling Rate (liters/min.)
Inside Abatement Area	5	0.45 microns	1500	2-16
Outside Abatement Area	5	0.45 microns	1500	2-16
Field Blank	2	0.45 microns	0	0
Laboratory Blank	1	0.45 microns	0	0

## Notes:

1. Type of filter is Mixed Cellulose Ester.
2. The detection limit for TEM analysis is 70 structures/square mm.

## CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME \_\_\_\_\_ CONTRACT NO. \_\_\_\_\_  
PROJECT ADDRESS \_\_\_\_\_  
CONTRACTOR FIRM NAME \_\_\_\_\_  
EMPLOYEE'S NAME \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_,  
(Print) (Last) (First) (MI)

Social Security Number: \_\_\_\_\_-\_\_\_\_\_-\_\_\_\_\_,

WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH TYPES OF LUNG DISEASE AND CANCER. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, THE CHANCE THAT YOU WILL DEVELOP LUNG CANCER IS GREATER THAN THAT OF THE NONSMOKING PUBLIC.

Your employer's contract for the above project requires that you be provided and you complete formal asbestos training specific to the type of work you will perform and project specific training; that you be supplied with proper personal protective equipment including a respirator, that you be trained in its use; and that you receive a medical examination to evaluate your physical capacity to perform your assigned work tasks, under the environmental conditions expected, while wearing the required personal protective equipment. These things are to be done at no cost to you. By signing this certification, you are acknowledging that your employer has met these obligations to you. The Contractor's Designated Industrial Hygienist will check the block(s) for the type of formal training you have completed. Review the checked blocks prior to signing this certification.

## FORMAL TRAINING:

\_\_\_\_\_ a. For Competent Persons and Supervisors: I have completed EPA's Model Accreditation Program (MAP) training course, "Contractor/Supervisor", that meets this State's requirements.

## b. For Workers:

\_\_\_\_\_ (1) For OSHA Class I work: I have completed EPA's MAP training course, "Worker", that meets this State's requirements.

\_\_\_\_\_ (2) For OSHA Class II work (where there will be abatement of more than one type of Class II materials, i.e., roofing, siding, floor tile, etc.): I have completed EPA's MAP training course, "Worker", that meets this State's requirements.

(3) For OSHA Class II work (there will only be abatement of one type of Class II material):

\_\_\_\_\_ (a) I have completed an 8-hour training class on the elements of 29 CFR 1926, Section .1101(k)(9)(viii), in addition to the specific work practices and engineering controls of 29 CFR 1926, Section .1101(g) and hands-on training.

\_\_\_\_\_ (b) I have completed EPA's MAP training course, "Worker", that meets this State's requirements.

\_\_\_\_\_ (4) For OSHA Class III work: I have completed at least a 16-hour course consistent with EPA requirements for training of local education agency maintenance and custodial staff at 40 CFR 763, Section .92(a)(2) and

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

the elements of 29 CFR 1926, Section .1101(k)(9)(viii), in addition to the specific work practices and engineering controls at 29 CFR 1926, Section .1101, and hands-on training.

## CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

\_\_\_\_\_ (5) For OSHA Class IV work: I have completed at least a 2-hr course consistent with EPA requirements for training of local education agency maintenance and custodial staff at 40 CFR 763, (a)(1), and the elements of 29 CFR 1926, Section .1101(k)(9)(viii), in addition to the specific work practices and engineering controls at 29 CFR 1926, Section .1101(g) and hands-on training.

\_\_\_\_\_ c. Workers, Supervisors and the Designated Competent Person: I have completed annual refresher training as required by EPA's MAP that meets this State's requirements.

## PROJECT SPECIFIC TRAINING:

\_\_\_\_\_ I have been provided and have completed the project specific training required by this Contract. My employer's Designated Industrial Hygienist and Designated Competent Person conducted the training.

## RESPIRATORY PROTECTION:

\_\_\_\_\_ I have been trained in accordance with the criteria in the Contractor's Respiratory Protection program. I have been trained in the dangers of handling and breathing asbestos dust and in the proper work procedures and use and limitations of the respirator(s) I will wear. I have been trained in and will abide by the facial hair and contact lens use policy of my employer.

## RESPIRATOR FIT-TEST TRAINING:

\_\_\_\_\_ I have been trained in the proper selection, fit, use, care, cleaning, maintenance, and storage of the respirator(s) that I will wear. I have been fit-tested in accordance with the criteria in the Contractor's Respiratory Program and have received a satisfactory fit. I have been assigned my individual respirator. I have been taught how to properly perform positive and negative pressure fit-check upon donning negative pressure respirators each time.

## MEDICAL EXAMINATION:

\_\_\_\_\_ I have had a medical examination within the last twelve months which was paid for by my employer. The examination included: health history, pulmonary function tests, and may have included an evaluation of a chest x-ray. A physician made a determination regarding my physical capacity to perform work tasks on the project while wearing personal protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination. My employer's Industrial Hygienist evaluated the medical certification provided by the physician and checked the appropriate blank below. The physician determined that there:

\_\_\_\_\_ were no limitations to performing the required work tasks.

\_\_\_\_\_ were identified physical limitations to performing the required work tasks.

Date of the medical examination \_\_\_\_\_

Employee Signature \_\_\_\_\_ date \_\_\_\_\_



CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

Contractor's Industrial

Hygienist Signature \_\_\_\_\_ date \_\_\_\_\_

-- End of Section --

## SECTION 13283N

REMOVAL/CONTROL AND DISPOSAL OF PAINT WITH LEAD  
02/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z88.2 (1992) Respiratory Protection

## CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926.21	Safety Training and Education
29 CFR 1926.33	Access to Employee Exposure and Medical Records
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead Exposure in Construction
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
29 CFR 1926.103	Respiratory Protection
40 CFR 260	Hazardous Waste Management Systems: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standard for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

40 CFR 268	Land Disposal Restrictions
40 CFR 745	Lead; Requirements for Lead-Based Paint Activities
49 CFR 172	Hazardous Materials, Tables, and Hazardous Materials Communications Regulations
49 CFR 178	Shipping Container Specification

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

HUD 6780	(1995) Guidelines for the Evaluation and Control of Lead Based Paint Hazards in Housing
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UNDERWRITERS LABORATORIES INC. (UL)

UL 586	(1996 R 1999) High-Efficiency, Particulate, Air Filter Units
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1.2 DEFINITIONS

1.2.1 Abatement

As applied to target housing and child occupied facilities, "abatement" means any set of measures designed to permanently eliminate lead-based paint hazards in accordance with standards established by appropriate Federal agencies. Such term includes:

- a. The removal of lead-based paint and lead-contaminated dust, the permanent containment or encapsulation of lead-based paint, the replacement of lead-painted surfaces or fixtures, and the removal or covering of lead contaminated soil; and
- b. All preparation, cleanup, disposal, and post-abatement clearance testing activities associated with such measures.

1.2.2 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period in a work environment.

1.2.3 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries, which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel.

1.2.4 Child Occupied Facility

A building or portion of a building constructed prior to 1978 visited regularly by the same child, 6 years of age or under, on a least two

different days within any week, provided each days visit last at least 3 hours and the combined weekly visit last at least 6 hours and the combined annual visit last at least 60 hours. Child occupied facilities may include, but are not limited to day-care centers, preschools and kindergarten classrooms.

#### 1.2.5 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations. A Certified Industrial Hygienist (CIH) certified for comprehensive practice by the American Board of Industrial Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is the best choice.

#### 1.2.6 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

#### 1.2.7 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

#### 1.2.8 Deleading

Activities conducted by a person who offers to eliminate lead-based paint or lead-based paint hazards or to plan such activities in commercial buildings, bridges or other structures.

#### 1.2.9 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead to which an employee is exposed, averaged over an 8 hour workday as indicated in 29 CFR 1926.62.

#### 1.2.10 High Efficiency Particulate Air (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron or larger size particles.

#### 1.2.11 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps.

#### 1.2.12 Lead-Based Paint (LBP)

Paint or other surface coating that contains lead in excess of 1.0 milligrams per centimeter squared or 0.5 percent by weight.

## 1.2.13 Lead-Based Paint Activities

In the case of target housing or child occupied facilities, lead-based paint activities include; a lead-based paint inspection, a risk assessment, or abatement of lead-based paint hazards.

## 1.2.14 Lead-Based Paint Hazard (LBP Hazard)

Any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, lead-based paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects.

## 1.2.15 Paint with Lead (PWL)

Any paint that contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint using laboratory instruments with specified limits of detection (usually 0.01%). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method.

## 1.2.16 Lead Control Area

A system of control methods to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

## 1.2.17 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a workday, the PEL shall be determined by the following formula:

$$\text{PEL (micrograms/cubic meter of air)} = 400/\text{No. hrs worked per day}$$

## 1.2.18 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

## 1.2.19 Physical Boundary

Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area but

inside the physical boundary."

#### 1.2.20 Target Housing

Housing constructed prior to 1978. It does not include housing for the elderly, or persons with disabilities unless any one or more children age 6 years and younger resides or is expected to reside in such housing.

### 1.3 DESCRIPTION

#### 1.3.1 Description of Work

Remove/control lead-based/paint with lead in poor condition, as indicated through XRF testing in the following locations:

Exterior brick walls  
Wood doors, door casings and door jambs  
Metal doors, door frames and door lintels  
Metal window frames  
Metal circle top window frame  
Metal window lintel  
Metal water pipe  
Wood mirror frame  
Concrete stair treads and stair risers  
Concrete floors  
Metal catwalk access ladder  
Metal roof structural support  
Wood soffit and fascia

Reference the hazardous materials survey report for further information.

#### 1.3.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Removal/Control Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead activities.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Vacuum Filters; G

Respirators; G

SD-06 Test Reports

sampling results; G

Occupational and Environmental Assessment Data Report; G

SD-07 Certificates

Qualifications of CP; G

Testing Laboratory qualifications; G

Occupant Notification; G

Training Certification of workers and supervisors; G

Notification of the Commencement of LBP Hazard Abatement; G

Third Party Consultant Qualifications; G

lead-based paint/paint with lead removal/control plan including CP approval (signature, date, and certification number); G

Rental equipment notification; G

Respiratory Protection Program; G

Hazard Communication Program; G

EPA or Commonwealth of Virginia approved hazardous waste treatment, storage, or disposal facility for lead disposal; G

Lead Waste Management Plan; G

Vacuum filters; G

Clearance Certification; G

SD-08 Manufacturer's Instructions

Chemicals and equipment; G

Materials; G

Material safety data sheets for all chemicals; G

SD-11 Closeout Submittals

Completed and signed hazardous waste manifest from treatment or

disposal facility; G

Certification of Medical Examinations; G

Employee Training Certification; G

Waste turn-in documents or weight tickets for non-hazardous wastes that are disposed of at sanitary or construction and demolition landfills; G

## 1.5 QUALITY ASSURANCE

### 1.5.1 Qualifications

#### 1.5.1.1 Qualifications of CP

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide previous experience of the CP. Submit proper documentation that the CP is trained, licensed and certified in accordance with Federal, State, and local laws.

#### 1.5.1.2 Training Certification

Submit a certificate for each employee and supervisor, signed and dated by the authorized training provider meeting 40 CFR 745 (Subpart L) requirements, stating that the employee or supervisor has received the required lead training and is certified to perform or supervise lead removal. Submit proof the work will be performed by a certified firm.

#### 1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air and soil sampling, testing, and reporting of airborne concentrations of lead. Use a laboratory accredited under the EPA National Lead Laboratory Accreditation Program (NLLAP) by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis. Laboratories selected to perform blood lead analysis shall be OSHA approved.

#### 1.5.1.4 Third Party Consultant Qualifications

Submit the name, address, and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust or soil sampling. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.



]1.5.2 Requirements

1.5.2.1 Competent Person (CP) Responsibilities

- a. Verify training meets all federal, State, and local requirements.
- b. Review and approve lead-based paint/paint with lead removal/control plan for conformance to the applicable standards. Ensure work is performed in strict accordance with specifications at all times.
- c. Continuously inspect lead-based paint removal/control work for conformance with the approved plan.
- d. Perform air and wipe sampling.
- e. Control work to prevent hazardous exposure to human beings and to the environment at all times.
- f. Certify the conditions of the work as called for elsewhere in this specification.

1.5.2.2 Lead-Based Paint/Paint with Lead Removal/Control Plan (LBP/PWL R/CP)

Submit a detailed job-specific plan of the work procedures to be used in the removal/control of LBP/PWL. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and paint debris disposal plan, air sampling plan, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside the lead control area. Include site preparation, cleanup and clearance procedures. Include occupational and environmental sampling, training, sampling methodology, frequency, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multi-contractor worksites to inform affected employees and to clarify responsibilities to control exposures.

1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

- a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data gathered during the task based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead containing coatings are present.

c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

#### 1.5.2.4 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62, and 29 CFR 1926.103. Maintain complete and accurate medical records of employees for a period of at least 30 years or for the duration of employment plus 30 years, whichever is longer.

#### 1.5.2.5 Training

Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations where appropriate.

#### 1.5.2.6 Respiratory Protection Program

a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

#### 1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

#### 1.5.2.8 Lead Waste Management

The Lead Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations and address:

a. Identification and classification of hazardous wastes associated

with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and operator and a 24-hour point of contact. Furnish two copies of proof of EPA, Commonwealth of Virginia, and local hazardous waste permit applications, permits, waste manifests, EPA Identification numbers and Transporter Number.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

g. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers.

h. Unit cost for waste disposal according to this plan.

#### 1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of Federal, State, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply. All Commonwealth of Virginia laws, ordinances, criteria, rules and regulations regarding removing, handling, storing, transporting, and disposing of lead-contaminated materials apply. lead-contaminated materials apply:

Licensing and certification in the Commonwealth of Virginia is required.

#### 1.5.3 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the lead waste management plan and the lead-based paint/paint with lead removal/control plan, including work procedures and precautions for the removal plan.

## 1.6 EQUIPMENT

### 1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust. Respirators shall comply with the requirements of 29 CFR 1926.62.

### 1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

### 1.6.3 Rental Equipment Notification

If rental equipment is to be used during lead-based paint handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Contracting Officer.

### 1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

### 1.6.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the paint removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

## 1.7 PROJECT/SITE CONDITIONS

### 1.7.1 Protection of Existing Work to Remain

Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.

## PART 2 PRODUCTS

Section 01525 Safety Requirements

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the Contracting Officer twenty 20 days prior to the start of any paint removal work.

b. Occupant Notification

Submit occupant written acknowledgment of the delivery of lead hazard information pamphlet (EPA 747-K-99-001 "Protect Your Family From Lead in Your Home") prior to commencing the renovation work for each affected unit per 40 CFR 745 Subpart E.

c. Notification of the Commencement of LBP Hazard Abatement

Submit a copy of the notification of the commencement of LBP hazard abatement to Owner's Representative according to the procedures established by all applicable federal and Commonwealth of Virginia requirements.

3.1.1.2 Boundary Requirements

a. Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside the lead control area.

b. Warning Signs - Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.1.1.3 Furnishings

The Government will remove furniture and equipment from the building before lead-based paint removal work begins.

3.1.1.4 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area.

3.1.1.5 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

## 3.1.1.6 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.

## 3.1.1.7 Mechanical Ventilation System

a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.62.

b. To the extent feasible, use local exhaust ventilation connected to HEPA filters or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.

c. Vent local exhaust outside the building only and away from building ventilation intakes.

d. Use locally exhausted, power actuated, paint removal tools.

## 3.1.1.8 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

## 3.2 ERECTION

## 3.2.1 Lead Control Area Requirements

Establish a lead control area by situating critical barriers and physical boundaries around the area or structure where LBP/PWL removal/control operations will be performed.

## 3.3 APPLICATION

## 3.3.1 Work Procedures

Perform removal of lead-based paint in accordance with approved lead-based paint/paint with lead removal/control plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-based paint is removed in accordance with 29 CFR 1926.62. Dispose of removed paint chips and associated waste in compliance with Environmental Protection Agency (EPA), State, and local requirements.

## 3.3.2 Lead-Based Paint Removal/Control/Deleading

Manual or power sanding of interior and exterior surfaces is not permitted unless tools are equipped with HEPA attachments or wet methods. The dry sanding or grinding of surfaces that contain lead is prohibited. Provide methodology for LBP removal/control in work plan. Remove paint within the

areas designated on the drawings in order to completely expose the substrate. Take whatever precautions necessary to minimize damage to the underlying substrate.

Provide methodology for LBP/PWL removal and processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris/waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this LBP/PWL removal/control process in the LBP/PWL R/CP.

#### 3.3.2.1 Indoor Paint Removal

Perform manual paint removal in lead control areas using enclosures, barriers, or containments. Collect debris for disposal in accordance with federal, State, and local requirements.

#### 3.3.2.2 Outdoor Paint Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the LBP/CPR/CP. The worksite preparation (barriers or containments) shall be job dependent and presented in the LBP/PWL R/CP.

#### 3.3.3 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:

- a. Vacuum themselves off.
- b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.
- c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing; move to an appropriate facility; shower.
- d. Change to clean clothes prior to leaving the physical boundary designated around the lead control area.

#### 3.4 FIELD QUALITY CONTROL

##### 3.4.1 Tests

##### 3.4.1.1 Air and Wipe Sampling

Air sample for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

- a. The CP shall be on the job site directing the air and non-clearance wipe sampling and inspecting the lead-based paint removal/control work to ensure that the requirements of the contract have been satisfied during the entire lead-based paint removal operation.

- b. Collect personal air samples on employees who are expected to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.
- c. Submit results of air samples, within 72 hours after the air samples are taken.
- d. Before any work begins, a third party consultant shall collect and analyze baseline wipe samples in accordance with methods defined in federal, State, and local standards inside and outside of the physical boundary to assess the degree of dust contamination in the facility prior to lead-based paint removal/control.
- e. Collect surface wipe samples at a location no greater than 10 feet outside the lead control area at a frequency of once per day while lead removal work is conducted. Surface wipe results shall meet criteria in paragraph "Clearance Certification."

#### 3.4.1.2 Air Sampling During Paint Removal Work

Conduct area air sampling daily, on each shift in which lead-based paint removal operations are performed, in areas immediately adjacent to the lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after the CP and the Contracting Officer give approval. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area.

#### 3.4.1.3 Sampling After Paint Removal/Control

After the visual inspection, conduct soil sampling if bare soil is present during external removal/control operations and collect wipe samples according to the HUD protocol contained in HUD 6780 to determine the lead content of settled dust and dirt in micrograms per square meter foot of surface area.

### 3.5 CLEANING AND DISPOSAL

#### 3.5.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the CP. Reclean areas showing dust or residual paint chips or debris. After visible dust, chips and debris is removed, wet wipe and HEPA vacuum all surfaces in the work area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The



CP shall then certify in writing that the area has been cleaned of lead contamination before restarting work.

#### 3.5.1.1 3.5.1.1 Clearance Certification

The CP shall certify in writing that air samples collected outside the lead control area during paint removal operations are less than 30 micrograms per cubic meter of air; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62 and 40 CFR 745; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

Certify surface wipe samples are not significantly greater than the initial surface loading determined prior to work.

If the main objective of the project is lead abatement, soil samples must be taken to determine the clearance of the work area prior to completion of all exterior paint removal/control work. Soil samples taken at the exterior of the work site shall be used to determine if soil lead levels had increased at a statistically significant level (significant at the 95 percent confidence limit) from the soil lead levels prior to the work. If soil lead levels do show a statistically significant increase or are above any applicable Federal or State standard for lead in soil, the soil shall be remediated back to the pre-work level.

For lead-based paint hazard abatement work, surface wipe and soil sampling shall be conducted and clearance determinations made according to the work practice standards presented in 40 CFR 745.227.

#### 3.5.2 Disposal

a. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing that may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 262. Dispose of lead-contaminated waste material at a Commonwealth of Virginia approved hazardous waste treatment, storage, or disposal facility off Government property.

b. Place waste materials in U.S. Department of Transportation (49 CFR 178) approved 55 gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. For hazardous waste, the collection drum requires marking/labeling in accordance with 40 CFR 262 during the accumulation/collection timeframe. The Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

c. Handle, transport, and dispose lead or lead-contaminated material classified as hazardous waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

d. All material, whether hazardous or non-hazardous shall be disposed in accordance with laws and provisions and Federal, State, or local regulations. Ensure waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

#### 3.5.2.1 Disposal Documentation

Submit written evidence to demonstrate the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA, State or local regulatory agencies. Submit one copy of the completed hazardous waste manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. Contractor shall provide a certificate that the waste was accepted by the disposal facility.

#### 3.5.3 Payment for Hazardous Waste

Payment for disposal of hazardous and non-hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials or non-hazardous waste delivered is returned and a copy is furnished to the Government.

-- End of Section --

13286N

HANDLING OF LIGHTING BALLASTS AND LAMPS CONTAINING PCBs AND MERCURY  
08/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Program
40 CFR 273	Standards For Universal Waste Management
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 178	Specifications for Packagings

## COMMONWEALTH OF VIRGINIA ADMINISTRATIVE CODE (VAC)

9 VAC 20-60	Hazardous Waste Regulations
9 VAC 20-80	Solid Waste Management Regulations

## 1.2 REQUIREMENTS

Removal and disposal of PCB containing lighting ballasts and associated mercury-containing lamps. Contractor may encounter leaking PCB ballasts.

### 1.2.1 Description of Work

#### Scope of Work (Waste Type A)

The Contractor is responsible for removing approximately seventy-five (75) PCB-containing light ballasts from the building. The ballasts will be packaged, labeled and disposed of as described below.

#### Scope of Work (Waste Type B)

The Contractor is responsible for removing approximately one hundred and fifty (150) fluorescent lamps from the building. The light bulbs will not be discarded but are to be recovered and recycled by the Contractor as described below.

## 1.3 DEFINITIONS

### 1.3.1 Certified Industrial Hygienist (CIH)

An industrial hygienist hired by the contractor shall be certified by the American Board of Industrial Hygiene

### 1.3.2 Contractor

The Contractor is that individual, or entity under contract to the Navy to perform the herein listed work.

### 1.3.2 Leak

Leak or leaking means any instance in which a PCB article, PCB container, or PCB equipment has any PCBs on any portion of its external surface.

### 1.3.3 Lamps

Lamp, also referred to as "universal waste lamp", is defined as the bulb or tube portion of an electric lighting device. A lamp is specifically designed to produce radiant energy, most often in the ultraviolet, visible, and infra-red regions of the electromagnetic spectrum. Examples of common universal waste electric lamps include, but are not limited to, fluorescent, high intensity discharge, neon, mercury vapor, high pressure sodium, and metal halide lamps.

### 1.3.4 Polychlorinated Biphenyls (PCBs)

PCBs as used in this specification shall mean the same as PCBs, PCB containing lighting ballast, and PCB container, as defined in 40 CFR 761, Section 3, Definitions.

#### 1.3.5 Spill

Spill means both intentional and unintentional spills, leaks, and other uncontrolled discharges when the release results in any quantity of PCBs running off or about to run off the external surface of the equipment or other PCB source, as well as the contamination resulting from those releases.

#### 1.3.6 Universal Waste

Universal Waste means any of the following hazardous wastes that are managed under the universal waste requirements 40 CFR 273:

- (1) Batteries as described in Sec. 273.2 of this chapter;
- (2) Pesticides as described in Sec. 273.3 of this chapter;
- (3) Thermostats as described in Sec. 273.4 of this chapter; and
- (4) Lamps as described in Sec. 273.5 of this chapter.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Regulatory Requirements

Perform PCB related work in accordance with 40 CFR 761 and 9 VAC 20-60 and 9 VAC 20-80. Perform mercury-containing lamps storage and transport in accordance with 40 CFR 261, 40 CFR 264, 40 CFR 265, 40 CFR 273 and 9 VAC 20-60 and 9 VAC 20-80.

#### 1.4.2 Training

Certified industrial hygienist (CIH) shall instruct and certify the training of all persons involved in the removal of PCB containing lighting ballasts and mercury-containing lamps. The instruction shall include: The dangers of PCB and mercury exposure, decontamination, safe work practices, and applicable OSHA and EPA regulations. The CIH shall review and approve the PCB and Mercury-Containing Lamp Removal Work Plans.

#### 1.4.3 Regulation Documents

Maintain at all times one copy each at the office and one copy each in view at the job site of 29 CFR 1910.1000, 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 265, 40 CFR 268, 40 CFR 270, 40 CFR 273 and 9 VAC 20-60 9 VAC 20-80 and of the Contractor removal work plan and disposal plan for PCB and for associated mercury-containing lamps.

### 1.5 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-07 Certificates

Qualifications of CIH; G

Training Certification; G

PCB and Lamp Removal Work Plan; G

PCB and Lamp Disposal Plan; G

SD-11 Closeout Submittals

Transporter certification of notification to EPA of their PCB waste activities and EPA ID numbers; G

Certification of Decontamination

Certificate of Disposal and/or recycling. Submit to the Government before application for payment within 30 days of the date that the disposal of the PCB and mercury-containing lamp waste identified on the manifest was completed.

DD Form 1348-1

Testing results

1.6 ENVIRONMENTAL REQUIREMENTS

Use special clothing:

- a. Disposable gloves (polyethylene)
- b. Eye protection
- c. PPE as required by CIH

1.7 SCHEDULING

Notify the Contracting Officer twenty 20calendar days prior to the start of PCB and mercury-containing lamp removal work.

1.8 QUALITY ASSURANCE

1.8.1 Qualifications of CIH

Submit the name, address, and telephone number of the Industrial Hygienist selected to perform the duties in paragraph entitled "Certified Industrial Hygienist." Submit training certification that the Industrial Hygienist is certified, including certification number and date of certification or re certification.

1.8.2 PCB and Lamp Removal Work Plan

Submit a job-specific plan within twenty 20 calendar days after award of contract of the work procedures to be used in the removal, packaging, and storage of PCB-containing lighting ballasts and associated mercury-containing lamps. Include in the plan: Requirements for Personal Protective Equipment (PPE), spill cleanup procedures and equipment, eating, smoking and restroom procedures. The plan shall be approved and signed by

the Certified Industrial Hygienist. Obtain approval of the plan by the Contracting Officer prior to the start of PCB and/or lamp removal work.

#### 1.8.3 PCB and Lamp Disposal Plan

Submit a PCB and lamp Disposal Plan with forty-five 45 calendar days after award of contract. The PCB and Lamp Disposal Plan shall comply with applicable requirements of federal, state, and local PCB and Universal waste regulations and address:

- a. Estimated quantities of wastes to be generated, disposed of, and recycled.
- b. Names and qualifications of each Contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location. Furnish two copies of EPA and state PCB and mercury-containing lamp waste permit applications and EPA identification numbers, as required.
- c. Names and qualifications (experience and training) of personnel who will be working on-site with PCB and mercury-containing lamp wastes.
- d. Spill prevention, containment, and cleanup contingency measures to be implemented.
- e. Work plan and schedule for PCB and mercury-containing lamp waste removal, containment, storage, transportation, disposal and or recycling. Wastes shall be cleaned up and containerize daily.

#### PART 2 PRODUCTS

Not used.

#### PART 3 EXECUTION

##### 3.1 WORK PROCEDURE

Furnish labor, materials, services, and equipment necessary for the removal of PCB containing lighting ballasts, associated mercury-containing fluorescent lamps in accordance with local, state, or federal regulations. Do not expose PCBs to open flames or other high temperature sources since toxic decomposition by-products may be produced. Do not brake mercury containing fluorescent lamps or high intensity discharge lamps.

##### 3.1.1 Work Operations

Ensure that work operations or processes involving PCB or PCB-contaminated materials are conducted in accordance with 40 CFR 761, 40 CFR 262 40 CFR 263, and the applicable requirements of this section, including but not limited to:

- a. Obtaining suitable PCB and mercury-containing lamp storage sites.

- b. Notifying Contracting Officer prior to commencing the operation.
- c. Reporting leaks and spills to the Contracting Officer.
- d. Cleaning up spills.
- e. Inspecting PCB and PCB-contaminated items and waste containers for leaks and forwarding copies of inspection reports to the Contracting Officer.
- f. Maintaining inspection, inventory and spill records.

### 3.2 PCB SPILL CLEANUP REQUIREMENTS

#### 3.2.1 PCB Spills

Immediately report to the Contracting Officer any PCB spills.

#### 3.2.2 PCB Spill Control Area

Rope off an area around the edges of a PCB leak or spill and post a "PCB Spill Authorized Personnel Only" caution sign. Immediately transfer leaking items to a drip pan or other container.

#### 3.2.3 PCB Spill Cleanup

40 CFR 761, subpart G. Initiate cleanup of spills as soon as possible, but no later than 24 hours of its discovery. Mop up the liquid with rags or other conventional absorbent. The spent absorbent shall be properly contained and disposed of as solid PCB waste.

#### 3.2.4 Records and Certification

Document the cleanup with records of decontamination in accordance with 40 CFR 761, Section 125, Requirements for PCB Spill Cleanup. Provide test results of cleanup and certification of decontamination.

### 3.3 REMOVAL

#### 3.3.1 Ballasts

As ballasts are removed from the lighting fixture, inspect label on ballast. Ballasts without a "No PCB" label shall be assumed to contain PCBs and containerized and disposed of as required under paragraphs STORAGE FOR DISPOSAL and DISPOSAL. If there are less than 1600 "No PCB" labeled lighting ballasts dispose of them as normal demolition debris. If there are more than 1600 "No PCB" labeled ballasts, establish whether the "No PCB" labeled ballasts contain diethylhexyl phthalate (DEHP) either by test or by checking with the ballast manufacturer indicated on the label. Submit testing results and/or written confirmation from the manufacturer to the Contracting Officer. If the ballasts do not contain DEHP, dispose of them as normal construction debris. If they do contain DEHP, dispose of them as hazardous material in accordance with Federal, State, and local



regulations. As a basis of bid assume ballasts with "No PCB" labels do not contain DEHP and may be disposed of as normal construction debris. If 1600 or more DEHP ballasts are disposed of in a 24 hour period, notify the National Response Team at 800-424-8802.

### 3.3.2 Lighting Lamps

Remove lighting tubes/lamps from the lighting fixture and carefully place (unbroken) into appropriate containers (original transport boxes or equivalent.) In the event of a lighting tube/lamp breaking, sweep and place waste in double plastic taped bags and dispose of as universal waste as specified herein.

### 3.4 STORAGE FOR DISPOSAL

#### 3.4.1 Storage Containers for PCBs

49 CFR 178. Store PCB in containers approved by DOT for PCB.

#### 3.4.2 Storage Containers for lamps

Store mercury containing lamps in appropriate DOT containers. The boxes shall be stored and labeled for transport in accordance with 40 CFR 273.

#### 3.4.3 Labeling of Waste Containers

Label with the following:

- a. Date the item was placed in storage and the name of the cognizant activity/building.
- b. "Caution Contains PCB," conforming to 40 CFR 761, CFR Subpart C. Affix labels to PCB waste containers.
- c. Label mercury-containing lamp waste in accordance with 40 CFR 273. Affix labels to all lighting waste containers.

### 3.5 DISPOSAL

Dispose of off Government property in accordance with EPA, DOT, and local regulations at a permitted site.

#### 3.5.1 Identification Number

Federal regulations 40 CFR 761, and 40 CFR 263 require that generators, transporters, commercial storers, and disposers of PCB waste possess U.S. EPA identification numbers. The contractor shall verify that the activity has a U.S. EPA generator identification number for use on the Uniform Hazardous Waste manifest. If not, the contractor shall advise the activity that it must file and obtain an I.D. number with EPA prior to commencement of removal work. For mercury containing lamp removal, Federal regulations 40 CFR 273 require that large quantity handlers of Universal waste (LQHUW) must provide notification of universal waste management to the appropriate EPA Region (or state director in authorized states), obtain an EPA

identification number, and retain for three years records of off-site shipments of universal waste. The contractor shall verify that the activity has a U.S. EPA generator identification number for use on the Universal Waste manifest. If not, the contractor shall advise the activity that it must file and obtain an I.D. number with EPA prior to commencement of removal work.

### 3.5.2 Transporter Certification

Comply with disposal and transportation requirements outlined in 40 CFR 761 and 40 CFR 263. Before transporting the PCB waste, sign and date the manifest acknowledging acceptance of the PCB waste from the Government. Return a signed copy to the Government before leaving the job site. Ensure that the manifest accompanies the PCB waste at all times. Submit transporter certification of notification to EPA of their PCB waste activities (EPA Form 7710-53).

#### 3.5.2.1 Certificate of Disposal and/or Recycling

40 CFR 761. Certificate for the PCBs and PCB items disposed shall include:

- a. The identity of the disposal and or recycling facility, by name, address, and EPA identification number.
- b. The identity of the PCB waste affected by the Certificate of Disposal including reference to the manifest number for the shipment.
- c. A statement certifying the fact of disposal and or recycling of the identified PCB waste, including the date(s) of disposal, and identifying the disposal process used.
- d. A certification as defined in 40 CFR 761.

-- End of Section --

## SECTION 13721A

SMALL INTRUSION DETECTION SYSTEM  
03/97

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI X3.92	(1981; R 1993) Data Encryption Algorithm
ANSI X3.154	(1988; R 1994) Office Machines and Supplies - Alphanumeric Machines-Keyboards Arrangement

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices
47 CFR 68	Connection of Terminal Equipment to the Telephone Network

## ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/EIA/TIA-232-F	(1997) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
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## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 142	(1991) IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

## INTERNATIONAL TELECOMMUNICATION UNION (ITU)

ITU V.34	(1994) Data Communication Over the
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Telephone Network A Modem Operating at  
Data Signaling Rates of up to 28,000 bits  
for use on the General Switched Telephone  
Network and on Leased Point-to-Point  
Two-Wire Telephone Type Circuits

ITU V.42 (1993) Data Communications Over the  
Telephone Network Error-Correcting  
Procedures for DCEs Using  
Asynchronous-to-Synchronous Conversion

ITU V.42 bis (1990) Data Compression Procedures for  
Data Circuit Terminating Equipment (DCE)  
Using Error Correction Procedures

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1997) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

NEMA ICS 1 (1993) Industrial Control and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 294 (1999) Access Control System Units

UL 639 (1997; Rev thru Mar 1999) Intrusion  
Detection Units

UL 681 (1999) Installation and Classification of  
Burglar and Holdup Alarm Systems

UL 796 (1999) Printed-Wiring Boards

UL 1037 (1999) Antitheft Alarms and Devices

UL 1076 (1995; Rev thru Feb 1999) Proprietary  
Burglar Alarm Units and Systems

1.2 SYSTEM DESCRIPTION

1.2.1 General

The Contractor shall configure the Intrusion Detection System (IDS) as described and shown, including Government Furnished Equipment (GFE). Computing devices, as defined in 47 CFR 15, shall be certified to comply with the requirements for Class A computing devices and labeled as set forth in 47 CFR 15.

### 1.2.2 Overall System Reliability Requirement

The system, including all components and appurtenances, shall be configured and installed to yield a mean time between failure (MTBF), as defined in IEEE Std 100, of at least 10,000 hours continuous operation.

### 1.2.3 Definitions

#### 1.2.3.1 Intrusion Alarm

An alarm resulting from the detection of a specified target and which results in an attempt to intrude into the protected area or when entry into an entry controlled area is attempted without successfully using entry control procedures.

#### 1.2.3.2 Nuisance Alarm

An alarm resulting from the detection of an alarm stimuli, but which does not represent an attempt to intrude into the protected area.

#### 1.2.3.3 Environmental Alarm

An alarm during environmental conditions which exceed those specified.

#### 1.2.3.4 False Alarm

An alarm when there is no alarm stimulus.

#### 1.2.3.5 Duress Alarm

An alarm condition which results from a set of pre-established conditions such as entering a special code into a keypad or by activating a switch. This alarm category shall take precedence over other alarm categories.

### 1.2.4 Probability of Detection

Each zone shall have a continuous probability of detection greater than 90 percent and shall be demonstrated with a confidence level of 95 percent. This probability of detection equates to 49 successful detections out of 50 tests or 98 successful detections out of 100 tests.

### 1.2.5 Standard Intruder and Intruder Movement

The system shall be able to detect an intruder that weighs 100 pounds or less and is 5 feet tall or less. The intruder shall be dressed in a long-sleeved shirt, slacks and shoes unless environmental conditions at the site require protective clothing. Standard intruder movement is defined as any movement such as walking, running, crawling, rolling, or jumping through a protected zone in the most advantageous manner for the intruder.

### 1.2.6 Electrical Requirements

Electrically powered IDS equipment shall operate on 120 or 240 volt 60 Hz AC sources as shown. Equipment shall be able to tolerate variations in the

voltage source of plus or minus 10 percent, and variations in the line frequency of plus or minus 2 percent with no degradation of performance.

#### 1.2.7 Power Line Surge Protection

Equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used for surge protection.

#### 1.2.8 Sensor Wiring and Communication Circuit Surge Protection

Inputs shall be protected against surges induced on sensor wiring. Outputs shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. All communications equipment shall be protected against surges induced on any communications circuit. All cables and conductors, except fiber optics, which serve as communications circuits from the console to field equipment, and between field equipment, shall have surge protection circuits installed at each end. Protection shall be furnished at equipment, and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 3 feet of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

#### 1.2.9 System Reaction

All alarms shall be annunciated on the displays within 1 second of their occurring at a local processor.

#### 1.2.10 Environmental Conditions

##### 1.2.10.1 Interior, Controlled Environment

All system components, except the console, installed in interior locations having controlled environments shall be rated for continuous operation under ambient environmental conditions of 36 to 122 degrees F dry bulb and 20 to 90 percent relative humidity, noncondensing.

##### 1.2.10.2 Interior, Uncontrolled Environment

All system components installed in interior locations having uncontrolled environments shall be rated for continuous operation under ambient environmental conditions of 0 to 122 degrees F dry bulb and 10 to 95 percent relative humidity, noncondensing.

## 1.2.10.3 Exterior Environment

System components that are installed in locations exposed to weather shall be rated for continuous operation under ambient environmental conditions of minus 30 to 122 degrees F dry bulb and 10 to 95 percent relative humidity, condensing. In addition, the system components shall be rated for continuous operation when exposed to performance conditions as specified in UL 294 and UL 639 for outdoor use equipment. In addition, components shall be rated for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 2 feet thick, measured vertically.

## 1.2.10.4 Central Station

All central station equipment shall, unless designated otherwise, be rated for continuous operation under ambient environmental conditions of 60 to 85 degrees F and a relative humidity of 20 to 80 percent.

## 1.2.11 System Capacity

The system shall monitor and control the number of inputs and outputs shown and shall include an expansion capability of a minimum of 25 percent.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

## Intrusion Detection System; G

- a. System block diagram.
- b. Console installation, block diagrams, and wiring diagrams.
- c. Processor installation, typical block, and wiring diagrams.
- d. Details of connections to power sources, including power supplies and grounding.
- e. Details of surge protection device installation.
- f. Sensor detection patterns.
- g. The qualifications of the Manufacturer, Contractor, and Installer to perform the work specified herein.

## Key Control Plan; G

Key control plan including the following:

- a. Procedures that will be used to log and positively control all keys during installation.
- b. A listing of all keys and where they are used.
- c. A listing of all persons allowed entry to the keys.

Spare Parts;

Data lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended for stocking.

Manufacturer's Instructions; G

Printed copies of manufacturer's recommendations for installation of materials prior to installation. Where installation procedures, or any part thereof, are required to be in accordance with manufacturer's recommendations, installation of the item will not be allowed to proceed until the recommendations are received and approved.

Testing; G

Test plan defining all tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Experience;

Written proof of specified experience requirements.

SD-06 Test Reports

Performance Verification Test;

Test reports, in booklet form with witness signatures verifying execution of tests. Reports shall show the field tests to verify compliance with the specified performance criteria. Test reports shall include records of the physical parameters verified during testing. Test reports shall be submitted within 14 days after completion of testing.

Materials and Equipment;

Where materials or equipment are specified to conform, be



constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

#### 1.4 TESTING

The Contractor shall perform site testing and adjustment of the completed intrusion detection system. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Government at least 14 days prior to the test, and in no case shall notice be given until after the Contractor has received written approval of the specific test procedures.

#### 1.5 LINE SUPERVISION

##### 1.5.1 Signal and Data Transmission System (DTS) Line Supervision

All signal or DTS lines between sensors and the alarm annunciation console shall be supervised by the system. The system shall supervise the signal lines by monitoring changes in the direct current that flows through the signal lines and a terminating resistor. The system shall initiate an alarm in response to a current change of 5 percent or greater. The system shall also initiate an alarm in response to opening, closing, shorting, or grounding of the signal and DTS lines.

##### 1.5.2 Data Encryption

The intrusion detection system shall incorporate data encryption equipment on data transmission media links as shown. The algorithm used for encryption shall be the Data Encryption Standard (DES) algorithm described in ANSI X3.92.

#### 1.6 DATA TRANSMISSION SYSTEM (DTS)

The Contractor shall provide data transmission systems as specified in Section 16792 WIRE LINE DATA TRANSMISSION SYSTEM and as shown.

#### 1.7 EXPERIENCE

The Contractor shall submit written proof that the following experience requirements are being met.

##### 1.7.1 Hardware Manufacturer

All system components shall be produced by manufacturers who have been regularly engaged in the production of intrusion detection system components of the types to be installed for at least 3 years.

### 1.7.2 Software Manufacturer

All system and application software shall be produced by manufacturers who have been regularly engaged in the production of intrusion detection system and application software of similar type and complexity as the specified system for at least 2 years.

### 1.7.3 System Installer

The system shall be installed by a contractor who has been regularly engaged in the installation of intrusion detection systems of similar type and complexity as the specified system for at least 2 years.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

#### 2.1.1 Materials and Equipment

Units of the same type of equipment shall be products of a single manufacturer. All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's model and serial number in a conspicuous place.

#### 2.1.2 Enclosures

System enclosures shall be as shown.

##### 2.1.2.1 Interior Sensor

Sensors to be used in an interior environment shall be housed in an enclosure that provides protection against dust, falling dirt, and dripping noncorrosive liquids.

##### 2.1.2.2 Interior Electronics

System electronics to be used in an interior environment shall be housed in enclosures which meet the requirements of NEMA 250 Type 12.

#### 2.1.3 Nameplates

Laminated plastic nameplates shall be provided for local processors. Each nameplate shall identify the local processor and its location within the system. Laminated plastic shall be 1/8 inch thick, white with black center core. Nameplates shall be a minimum of 1 by 3 inches, with minimum 1/4 inch high engraved block lettering. Nameplates shall be attached to the inside of the enclosure housing the local processor. Other major components of the system shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a corrosion resistant plate secured to the item of equipment. Nameplates will not be required for devices smaller than 1 by 3 inches.

## 2.1.4 Tamper Provisions

## 2.1.4.1 Tamper Switches

Enclosures, cabinets, housings, boxes, and fittings of every description having hinged doors or removable covers and which contain circuits or connections of the intrusion detection system and its power supplies, shall be provided with cover operated, corrosion-resistant tamper switches, arranged to initiate an alarm signal when the door or cover is moved. The enclosure and the tamper switch shall function together in such a manner as to not allow direct line of sight to any internal components before the switch activates. Tamper switches shall be inaccessible until the switch is activated; have mounting hardware so concealed that the location of the switch cannot be observed from the exterior of the enclosure; be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating; shall be spring-loaded and held in the closed position by the door or cover; and shall be wired so that they break the circuit when the door or cover is disturbed.

- a. Nonsensor Enclosures: Tamper switches on nonsensor enclosures, which must be opened to make routine maintenance adjustments to the system and to service the power supplies, shall be push/pull-set, automatic reset type.
- b. Sensor Enclosures: Tamper switches on sensor enclosures, which must be opened to make routine maintenance adjustments to the sensor, shall be single pole single throw type.

## 2.1.4.2 Enclosure Covers

Covers of pull and junction boxes provided to facilitate initial installation of the system need not be provided with tamper switches if they contain no splices or connections, but shall be protected by tack welding or brazing the covers in place or by tamper resistant security fasteners. Labels shall be affixed to such boxes indicating they contain no connections.

## 2.1.5 Locks and Key-Lock Switches

## 2.1.5.1 Locks

Locks shall be installed on system enclosures for maintenance purposes. Locks shall be UL listed, conventional key type lock having a combination of five cylinder pin and five-point three position side bar. Keys shall be stamped "U.S. GOVT. DO NOT DUP." The locks shall be so arranged that the key can only be withdrawn when in the locked position. All maintenance locks shall be keyed alike and only two keys shall be furnished for all of these locks. These keys shall be controlled in accordance with the key control plan.

## 2.1.5.2 Key-Lock-Operated Switches

All key-lock-operated switches required to be installed on system

components shall be UL listed, conventional key type lock having a combination of five cylinder pin and five-point three position side bar. Keys shall be stamped "U.S. GOVT. DO NOT DUP." Key-lock-operated switches shall be two position, with the key removable in either position. All key-lock-operated switches shall be keyed differently and only two keys shall be furnished for each key-lock-operated-switch. These keys shall be controlled in accordance with the key control plan.

#### 2.1.5.3 Construction Locks

If the Contractor requires locks during installation and construction, a set of temporary locks shall be used. The final set of locks installed and delivered to the Government shall not include any of the temporary locks.

#### 2.1.6 Application of System Component

System components shall be designed for continuous operation. Electronic components shall be solid state type, mounted on printed circuit boards conforming to UL 796. Printed circuit board connectors shall be plug-in, quick-disconnect type. Power dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current carrying capacity. Light duty relays and similar switching devices shall be solid state type or sealed electro-mechanical.

##### 2.1.6.1 Maintainability

Components shall be designed to be maintained using commercially available tools and equipment. Components shall be arranged and assembled so they are accessible to maintenance personnel. There shall be no degradation in tamper protection, structural integrity, EMI/RFI attenuation, or line supervision after maintenance when it is performed in accordance with manufacturer's instructions. The system shall be configured and installed to yield a mean time to repair (MTTR) of not more than 8 hours. Repair time is the clock time from the time maintenance personnel are given entrance to the system and begin work, until the system is fully functional.

##### 2.1.6.2 Interchangeability

The system shall be constructed with off-the-shelf components which are physically, electrically and functionally interchangeable with equivalent components as complete items. Replacement of equivalent components shall not require modification of either the new component or of other components with which the replacement items are used. Custom designed or one-of-a-kind items shall not be used. Interchangeable components or modules shall not require trial and error matching in order to meet integrated system requirements, system accuracy, or restore complete system functionality.

##### 2.1.6.3 Electromagnetic and Radio Frequency Interference (EMI/RFI)

System components generating EMI/RFI shall be designed and constructed in accordance with 47 CFR 15.

## 2.1.6.4 Product Safety

System components shall conform to applicable rules and requirements of NFPA 70. System components shall be equipped with instruction plates, including warnings and cautions, describing physical safety, and special or important procedures to be followed in operating and servicing system equipment.

## 2.1.7 Controls and Designations

Controls and designations shall be as specified in NEMA ICS 1.

## 2.1.8 Special Test Equipment

The Contractor shall provide all special test equipment, special hardware, software, tools, and programming or initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.

## 2.1.9 Alarm Output

The alarm output of each sensor shall be a single pole double throw (SPDT) contact rated for a minimum of 0.25 A at 24 volts DC.

## 2.1.10 Alarm Indicator Lights

Indicator lights used throughout the system shall be light emitting diodes (LED) or long life incandescent lamps. The indicator lights used shall be visible from a distance of 30 feet in an area illuminated to 75 foot candles. The indicator lights shall conform to the following color coding:

- a. FLASHING RED to alert an operator that a zone has gone into an unacknowledged alarm or that primary power has failed.
- b. RED to alert an operator that a zone is in alarm and that the alarm has been acknowledged.
- c. YELLOW to advise an operator that a zone is in access.
- d. GREEN to indicate that a zone is secure or that power is on.

## 2.1.11 Access/Secure Devices

Access/secure devices shall be used to place a protected zone in ACCESS. The device shall disable all sensor alarm outputs, with the exception of tamper alarm outputs within the protected zone, and sensors in zones above false ceilings or other inaccessible locations as shown.

## 2.1.11.1 Switches

The switch shall consist of a double pull key-operated switch housed in a NEMA 12 equivalent enclosure.

## 2.1.11.2 Key Pads

Secure/Access keypads shall use a unique combination of alphanumeric and other symbols as an identifier. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII code ordinal sequence. The keypad shall have a contact output.

## 2.2 INTERIOR SENSORS

## 2.2.1 Balanced Magnetic Switch (BMS)

The BMS shall detect 1/4 inch of separating relative movement between the magnet and the switch housing. Upon detecting such movement, it shall transmit an alarm signal to the alarm annunciation system.

## 2.2.1.1 BMS Subassemblies

The BMS shall consist of a switch assembly and an actuating magnetic assembly. The switch mechanism shall be of the balanced magnetic type. Each switch shall be provided with an overcurrent protective device, rated to limit current to 80 percent of the switch capacity. Switches shall be rated for a minimum lifetime of one million operations. The housings of surface mounted switches and magnets shall be made of nonferrous metal and shall be weatherproof. The housings of recess mounted switches and magnets shall be made of nonferrous metal or plastic.

## 2.2.1.2 Remote Test

A remote test capability shall be provided. The remote test shall be initiated when commanded by the alarm annunciation system. The remote test shall activate the sensor's switch mechanism causing an alarm signal to be transmitted to the alarm annunciation system. The remote test shall simulate the movement of the actuating magnet relative to the switch subassembly.

## 2.2.2 Duress Alarm Switches

Duress alarm switches shall provide the means for an individual to covertly notify the alarm annunciation system that a duress situation exists.

## 2.2.2.1 Footrail

Footrail duress alarms shall be designed to be foot activated and floor mounted. No visible or audible alarm or noise shall emanate from the switch when activated. The switch shall lock in the activated position until manually reset with a key. The switch housing shall shroud the activating lever to prevent accidental activation. Switches shall be rated for a minimum lifetime of 50,000 operations.

## 2.2.2.2 Pushbutton

Latching pushbutton duress alarms shall be designed to be activated by depressing a pushbutton located on the duress switch housing. No visible or audible alarm or noise shall emanate from the switch. The switch shall

lock in the activated position until manually reset with a key. The switch housing shall shroud the activating button to prevent accidental activation. Switches shall be rated for a minimum lifetime of 50,000 operations.

#### 2.2.2.3 Wireless

Wireless duress alarms shall consist of portable alarm transmitters and permanently installed receivers. The transmitter shall be activated by depressing a pushbutton located on the housing. An alarm signal shall be transmitted to one or more receivers located within a protected zone. The receivers shall, in-turn, transmit an alarm signal to the alarm annunciation system. No visible or audible alarm or noise shall emanate from the transmitter or receiver when activated. The receiver shall lock in a transmitting mode until manually reset. The transmitter housing shall shroud the activating button to prevent accidental activation. The transmitter shall be designed to be unobtrusive and still be activated in a covert manner. Switches shall be rated for a minimum lifetime of 50,000 operations. The transmitters shall have a range of 100 feet.

#### 2.2.3 Microwave Motion Sensor

The transmitted microwave motion sensor shall detect changes in a microwave signal. Upon detecting a specific change, the sensor shall transmit an alarm signal to the alarm annunciation system. The sensor shall detect a standard intruder moving within the sensor's detection pattern at a speed of 0.3 to 7.5 feet per second. The sensor shall comply with 47 CFR 15 Subpart F. The sensor's coverage pattern shall be as shown. The sensitivity of the sensor shall be adjustable by controls within the sensor. The controls shall not be accessible when the sensor housing is in place. The sensor shall be adjustable to obtain the coverage shown.

##### 2.2.3.1 Test Indicator, Microwave Signal

The microwave motion sensor shall be equipped with an LED walk test indicator. The walk test indicator shall not be visible during normal operations. When visible, the walk test indicator shall light when the sensor detects an intruder. The sensor shall either be equipped with a manual control, located within the sensor's housing, to enable/disable the test indicator or the test indicator shall be located within the sensor such that it can only be seen when the housing is open/removed.

##### 2.2.3.2 Remote Test, Microwave Signal

A remote test capability shall be provided. The remote test hardware may be integral to the sensor or a separate piece of equipment. The remote test shall be initiated when commanded by the alarm annunciation system. The remote test shall excite the sensing element and associated electronics causing an alarm signal to be transmitted to the alarm annunciation system.

The sensor stimulation generated by the remote test hardware shall simulate a standard intruder moving within the sensor's detection pattern.

#### 2.2.4 Passive Infrared Motion Sensor

The passive infrared motion sensor shall detect changes in the ambient level of infrared emissions caused by the movement of a standard intruder within the sensor's field of view. Upon detecting such changes, the sensor shall transmit an alarm signal to the alarm annunciation system. The sensor shall detect a change in temperature of no more than 2 degrees F, and shall detect a standard intruder traveling within the sensor's detection pattern at a speed of 0.3 to 7.5 feet per second across two adjacent segments of the field of view. Emissions monitored by the sensor shall be in the 8 to 14 micron range. The sensor shall be adjustable to obtain the coverage pattern shown. The sensor shall be equipped with a temperature compensation circuit.

##### 2.2.4.1 Test Indicator, Infrared Emissions

The passive infrared motion sensor shall be equipped with an LED walk test indicator. The walk test indicator shall not be visible during normal operations. When visible, the walk test indicator shall light when the sensor detects an intruder. The sensor shall either be equipped with a manual control, located within the sensor's housing, to enable/disable the test indicator or the test indicator shall be located within the sensor such that it can only be seen when the housing is open/removed.

##### 2.2.4.2 Remote Test, Infrared Emissions

A remote test capability shall be provided. The remote test hardware may be integral to the sensor or a separate piece of equipment. The remote test shall be initiated when commanded by the alarm annunciation system. The remote test shall excite the sensing element and associated electronics causing an alarm signal to be transmitted to the alarm annunciation system.

The sensor stimulation generated by the remote test hardware shall simulate a standard intruder moving within the sensor's detection pattern.

#### 2.2.5 Microwave-Passive Infrared Dual Detection Motion Sensor

The dual detection motion sensor shall be a single unit combining a detector which detects changes in the transmitted microwave signal and a detector which detects changes in the ambient level of infrared emissions caused by the movement of a standard intruder within the detection pattern.

The detection pattern shall be capable of covering a 20 by 30 feet room. Upon detection of changes by either detector, a window of more than 3 seconds but less than 8 seconds shall be opened. If the other detector detects a change during this window, the sensor shall transmit an alarm signal to the alarm annunciation system. The passive infrared detector shall detect a change in temperature of no more than 2 degrees F, and shall detect a standard intruder traveling within the detection pattern at a speed of 0.3 to 7.5 feet per second across two adjacent segments of the field of view. Emissions monitored by the sensor shall be in the range of 8 to 14 microns. The microwave detector shall detect a standard intruder moving within the detection pattern at a speed of 0.3 to 7.5 feet per second. The microwave detector shall comply with 47 CFR 15 Subpart F. The controls shall not be accessible when the sensor housing is in place. The sensor shall be configured to produce an alarm when both detectors sense a



target.

#### 2.2.5.1 Test Indicator

The sensor shall be equipped with an LED walk test indicator for both the passive infrared detector and the microwave detector. The walk test indicator shall not be visible during normal operations. When visible, the walk test indicator shall light when the sensor detects an intruder. The sensor shall either be equipped with a manual control, located within the sensor's housing, to enable/disable the test indicators or the test indicators shall be located within the sensor such that it can only be seen when the housing is open/removed.

#### 2.2.5.2 Remote Test

A remote test capability shall be provided. The remote test hardware may be integral to the sensor or a separate piece of equipment. The remote test shall be initiated when commanded by the alarm annunciation system. The remote test shall excite each sensing element and associated electronics causing an alarm signal to be transmitted to the alarm annunciation system. The sensor stimulation generated by the remote test hardware shall simulate a standard intruder moving within the sensor's detection pattern.

#### 2.2.6 Photo-Electric Sensor

The photo-electric sensor shall detect an interruption of the light beam that links the transmitter and receiver caused by a standard intruder walking at a speed of less than 7.5 feet per second through the beam. Upon detecting such an interruption, the sensor shall transmit an alarm signal to the alarm annunciation system. The sensor shall use a pulsed infrared light source. Multiple sensors shall be able to operate within the same zone without interfering with each other. The coverage pattern shall be as shown.

##### 2.2.6.1 Test Indicator, Photo-Electric System

The sensor shall be equipped with an LED walk test indicator. The walk test indicator shall not be visible during normal operations. When visible, the walk test indicator shall light when the sensor detects an intruder. The sensor shall either be equipped with a manual control, located within the sensor's housing, to enable/disable the test indicator or the test indicator shall be located within the sensor so that it can only be seen when the housing is open/removed.

##### 2.2.6.2 Remote Test, Photo Electric System

A remote test capability shall be provided. The remote test hardware may be integral to the sensor or a separate piece of equipment. The remote test shall be initiated when commanded by the alarm annunciation system. The remote test shall excite each sensing element and associated electronics causing an alarm signal to be transmitted to the alarm annunciation system. The sensor stimulation generated by the remote test hardware shall simulate a standard intruder moving within the sensor's

detection pattern.

## 2.3 CENTRAL STATION HARDWARE

The central station computer shall be a standard unmodified digital computer of modular design. The CPU word size shall be 64 bits or larger. The operating speed of the processor shall be at least 150 MHZ.

### 2.3.1 Memory

The computer shall contain at least 40 megabytes of usable installed memory.

### 2.3.2 Power Supply

The power supply shall have a minimum capacity of 250 Watts.

### 2.3.3 Serial Port

- a. One EIA ANSI/EIA/TIA-232-F serial port shall be provided for general use.
- b. Adjustable data transmission rates from 9600 to 57.6 kbps shall be selectable under program control.

### 2.3.4 Parallel Port

An enhanced parallel port shall be provided.

### 2.3.5 Modem

Modem shall operate at 28.000 bps, full duplex on circuits using asynchronous communications. The modem shall have error detection, auto answer/autodial, and call progress detection. The modem shall meet the requirements of ITU V.34, ITU V.42 for error correction and ITU V.42 bis for data compression standards, and shall be suitable for operating on unconditioned voice grade telephone lines in conformance with 47 CFR 68.

### 2.3.6 Audible Alarm

The manufacturer's standard audible alarm shall be provided.

### 2.3.7 Uninterruptible Power Supply (UPS)

A self contained UPS, suitable for installation and operation at the central station, shall be provided sized to provide a minimum of 6 hours of operation of the central station equipment. Equipment connected to the UPS shall not be affected in any manner by a power outage of a duration less than the rated capacity of the UPS. UPS shall be complete with all necessary power supplies, transformers, batteries, and accessories and shall include visual indication of normal power operation, UPS operation, abnormal operation and visual and audible indication of low battery power. The UPS shall be as specified in Section 16265 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM ABOVE 15 kVA CAPACITY.

## 2.4 SOFTWARE

The software shall support all specified functions. The central station shall be online at all times and shall perform all required functions as specified. Software shall be resident at the central station and/or the local processor as required to perform all specified functions.

### 2.4.1 System Software

The operating system shall perform the following functions:

- a. Support multiuser operator with multiple tasks for each user.
- b. Support operation and management of all peripheral devices.
- c. Provide file management functions for disk I/O, including creation and deletion of files, copying of files, a directory of all files including size and location of each sequential and random ordered records.

### 2.4.2 Applications Software

#### 2.4.2.1 Operator Commands

The operator's commands shall provide the means for entry of monitoring and control commands, and for retrieval of system information. Processing of operator commands shall commence within 1 second of entry, with some form of acknowledgment provided at that time. The operator's commands shall perform tasks including:

- a. Request help with the system operation.
- b. Acknowledge alarms.
- c. Place zone in access.
- d. Place zone in secure.
- e. Test the system.
- f. Change operator.

#### 2.4.2.2 Command Input

Operator's commands shall be full English language words and acronyms selected to allow operators to use the system without extensive training or data processing backgrounds. The system shall prompt the operator in English word, phrase, or acronym. Commands shall be available in an abbreviated mode, in addition to the full English language (words and acronyms) commands, allowing an experienced operator to disregard portions, or all, of the prompt-response requirements.

#### 2.4.2.3 Command Input Errors

The system shall supervise operator inputs to ensure they are correct for proper execution. Operator input assistance shall be provided whenever a command cannot be executed because of operator input errors. The system shall explain to the operator, in English words and phrases, why the command cannot be executed. The error responses requiring an operator to look up a code in a manual or other document are not acceptable. Conditions for which operator error assist messages shall be generated include:

- a. The command used is incorrect or incomplete.
- b. The operator is restricted from using that command.
- c. The command addresses a point which is disabled or out of service.
- d. The command addresses a point which does not exist.
- e. The command would violate constraints.

#### 2.4.2.4 Enhancements

The system shall implement the following enhancements by use of special function keys, touch screen, or mouse, in addition to all other command inputs specified:

- a. Help: Used to produce a display for all commands available to the operator. The help command, followed by a specific command shall produce a short explanation of the purpose, use, and system reaction to that command.
- b. Acknowledge Alarms: Used to acknowledge that the alarm message has been observed by the operator.
- c. Place Zone in Access: Used to remotely disable all intrusion alarm circuits emanating from a specific zone. The system shall be structured so that tamper circuits cannot be disabled by the console operator.
- d. Place Zone in Secure: Used to remotely activate all intrusion alarm circuits emanating from a specific zone.
- e. System Test: Allows the operator to initiate a system wide operational test.
- f. Zone Test: Allows the operator to initiate an operational test for a specific zone.

#### 2.4.3 Site Specific Database Software

##### 2.4.3.1 Database Definition Process

Software shall be provided to define and modify each point in the database

using operator commands. The definition shall include all physical parameters and constraints associated with each sensor, commandable output, zone, etc. Each database item shall be callable for display or printing, including EEPROM, ROM and RAM resident data. The database shall be defined and entered into the central station by the Contractor based upon input from the Government.

#### 2.4.3.2 System Access Control

The system shall provide a means to define system operator capability and functions through multiple, password operated protected operator levels. At least 3 operator levels shall be provided. System operators and managers with appropriate password clearances shall be able to change operator levels for all operators. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm. A minimum of 32 passwords shall be usable with the intrusion detection system software. The system shall display the operator's name or initials in the console's first field.

The system shall print the operator's name or initials, action, date, and time on the system printer at log-on and log-off. The password shall not be displayed or printed. Each password shall be definable and assignable for the following:

- a. Commands usable.
- b. Access to system software.
- c. Access to application software.
- d. Individual zones which are to be accessed.
- e. Access to database.

#### 2.4.3.3 Alarm Monitoring Software

This program shall monitor all sensors, local processors and DTS circuits and notify the operator of an alarm condition. All alarms shall be printed in red on the alarm printer and displayed on the console's text and graphics map monitors. Higher priority alarms shall be displayed first and within alarm priorities. The oldest unacknowledged alarm shall be displayed first. Operator acknowledgment of one alarm shall not be considered as acknowledgment of any other alarm nor shall it inhibit reporting of subsequent alarms. Alarm data to be displayed shall include type of alarm, and location of alarm, and secondary alarm messages. Alarm data to be printed shall include: type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator response. A unique message field with a width of 60 characters shall be provided for each alarm. Assignment of messages to a zone or sensor shall be an operator editable function. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator. The system shall provide for 25 secondary messages with a field of 4 lines of 60 characters each. The most recent 1000 alarms shall be stored and shall be recallable by the operator using the report generator.

#### 2.4.3.4 Monitor Display Software

Monitor display software shall be provided for text and graphics map displays that include zone status integrated into the display. Different colors shall be used for the various components and real time data. Colors shall be uniform on all displays. The following color coding shall be followed.

- a. FLASHING RED to alert an operator that a zone has gone into an alarm or that primary power has failed.
- b. RED to alert an operator that a zone is in alarm and that the alarm has been acknowledged.
- c. YELLOW to advise an operator that a zone is in access.
- d. GREEN to indicate that a zone is secure or that power is on.

#### 2.4.3.5 System Test Software

This software shall enable the operator to initiate a test of the system. This test can be of the entire system or a particular portion of the system at the operator's option. The results of each test shall be stored for future display or print out in report form.

### 2.5 FIELD PROCESSING HARDWARE

#### 2.5.1 Alarm Annunciation Local Processor

The alarm annunciation local processor shall respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station and change outputs based on commands received from the central station. The local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.

- a. Inputs. Local processor inputs shall monitor dry contacts for change of state that reflect alarm conditions. The local processor shall have at least 8 alarm inputs which allow wiring as normally open or normally closed contacts for alarm conditions; and shall also provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements. The local processor shall report for any condition that remains off normal at an input for longer than 500 milliseconds. Each alarm condition shall be transmitted to the central computer during the next interrogation cycle.
- b. Outputs. Local processor outputs shall reflect the state of commands issued by the central station. The outputs shall be a form C contact and shall include normally open and normally closed contacts. The local processor shall have at least 4 command outputs.

### 2.5.2 Processor Power Supply

Local processor and sensors shall be powered from an uninterruptible power source. The uninterruptible power source shall provide 6 hours of battery back-up power in the event of primary power failure and shall automatically fully recharge the batteries within 12 hours after primary power is restored. There will be no equipment malfunctions or perturbations or loss of data during the switch from primary to battery power and vice versa. Batteries shall be sealed, non-outgassing type. The power supply shall be equipped with an indicator for ac input power and an indicator for dc output power. Loss of primary power shall be reported to the central station as an alarm.

### 2.5.3 Auxiliary Equipment Power

A GFI service outlet shall be furnished inside the local processor's enclosure.

## 2.6 FIELD PROCESSING SOFTWARE

All field processing software described in this specification shall be furnished as part of the complete system.

### 2.6.1 Operating System

Each local processor shall contain an operating system that controls and schedules that local processor's activities in real time. The local processor shall maintain a point database in its memory that includes all parameters, constraints, and the latest value or status of all points connected to that local processor. The execution of local processor application programs shall utilize the data in memory resident files. The operating system shall include a real time clock function that maintains the seconds, minutes, hours, date and month, including day of the week. Each local processor real time clock shall be automatically synchronized with the central station clock at least once per day to plus or minus 10 seconds. The time synchronization shall be accomplished without operator intervention and without requiring system shutdown.

#### 2.6.1.1 Startup

The local processor shall have startup software that causes automatic commencement of operation without human intervention, including startup of all connected functions. A local processor restart program based on detection of power failure at the local processor shall be included in the local processor software. The startup software shall initiate operation of self-test diagnostic routines. Upon failure of the local processor, if the database and application software are no longer resident, the local processor shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made. If the database and application programs are resident, the local processor shall immediately resume operation.

#### 2.6.1.2 Operating Mode

Each local processor shall control and monitor inputs and outputs as specified, independent of communications with the central station. Alarms, status changes and other data shall be transmitted to the central station when communications circuits are operable. If communications are not available, each local processor shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the central station shall be stored for later transmission to the central station. Storage for the latest 1024 events shall be provided at each local processor. Each local processor shall accept software downloaded from the central station.

#### 2.6.1.3 Failure Mode

Upon failure for any reason, each local processor shall perform an orderly shutdown and force all local processor outputs to a predetermined (failure mode) state, consistent with the failure modes shown and the associated control device.

#### 2.6.2 Functions

The Contractor shall provide all software necessary to accomplish the following functions, as appropriate, fully implemented and operational, within each local processor.

- a. Monitoring of inputs.
- b. Control of outputs.
- c. Reporting of alarms automatically to central station.
- d. Reporting of sensor and output status to central station upon request.
- e. Maintenance of real time, updated by the central station at least once a day.
- f. Communication with the central station.
- g. Execution of local processor resident programs.
- h. Diagnostics.
- i. Download and upload data to and from the central station.

#### 2.7 WIRE AND CABLE

##### 2.7.1 General

The Contractor shall provide all wire and cable not indicated as Government furnished equipment. All wiring shall meet NFPA 70 standards.



### 2.7.2 Above Ground Sensor Wiring

Sensor wiring shall be 20 AWG minimum, twisted and shielded, 2, 3, 4, or 6 pairs to match hardware. Multiconductor wire shall have an outer jacket of PVC.

### 2.7.3 Class 2 Low Energy Conductors

The conductor sizes specified for digital functions shall take precedence over any requirements for Class 2 low energy signal-circuit conductors specified elsewhere.

## PART 3 EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

The Contractor shall install all system components, including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown, and shall furnish necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown.

#### 3.1.1 Installation

The Contractor shall install the system in accordance with the standards for safety, NFPA 70, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type. Components within the system shall be configured with appropriate service points to pinpoint system trouble in less than 20 minutes. Minimum size of conduit shall be 1/2 inch. DTS shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring. Flexible cords or cord connections shall not be used to supply power to any components of the system, except where specifically noted herein. All other electrical work shall be as specified and as shown. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

#### 3.1.2 Enclosure Penetrations

All enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

#### 3.1.3 Cold Galvanizing

All field welds and/or brazing on factory galvanized components, such as boxes, enclosures, and conduits, shall be coated with a cold-galvanized paint containing at least 95 percent zinc by weight.

### 3.2 SYSTEM STARTUP

The Contractor shall not apply power to the intrusion detection system until the following items have been completed:

- a. Intrusion detection system equipment items and DTS have been set up in accordance with manufacturer's instructions.
- b. A visual inspection of the intrusion detection system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
- c. System wiring has been tested and verified as correctly connected as indicated.
- d. All system grounding and transient protection systems have been verified as properly installed and connected as indicated.
- e. Power supplies to be connected to the intrusion detection system have been verified as the correct voltage, phasing, and frequency as indicated.
- f. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work/equipment.

### 3.3 SITE TESTING

#### 3.3.1 General

The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform the site testing. The Government will witness all testing. Written permission shall be obtained from the Government before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test.

#### 3.3.2 Contractor's Field Testing

The Contractor shall calibrate and test all equipment, verify data transmission system (DTS) operation, place the integrated system in service, and test the integrated system. Ground rods installed by the Contractor shall be tested as specified in IEEE Std 142. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

#### 3.3.3 Performance Verification Test

The Contractor shall demonstrate that the completed system complies with

the specified requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown.

The performance verification test, as specified, shall not be started until receipt by the Contractor of written permission from the Government, based on the Contractor's written request. This shall include certification of successful completion of testing as specified in paragraph Contractor's Field Testing, and upon successful completion of training as specified. Upon successful completion of the performance verification test, the Contractor shall deliver test reports and other documentation to the Government, as specified. The Contractor will not be held responsible for failures in system performance resulting from the following:

- (1) An outage of the main power in excess of the capability of any backup power source, provided that the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the system performed as specified.
- (2) Failure of a Government furnished communications link, provided that the failure was not due to Contractor furnished equipment, installation, or software.
- (3) Failure of existing Government owned equipment, provided that the failure was not due to Contractor furnished equipment, installation, or software.
- (4) The occurrence of specified nuisance alarms.
- (5) The occurrence of specified environmental alarms.

-- End of Section --

SECTION 13851A

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE  
**02/02**

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41 (1990; R 1996) Audible Emergency  
Evacuation Signal

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a (1998) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in  
Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1221 (1999) Installation, Maintenance and Use  
of Public Fire Service Communication  
Systems

NFPA 70 (2002) National Electrical Code

NFPA 72 (2002) National Fire Alarm Code

NFPA 90A (1999) Installation of Air Conditioning  
and Ventilating Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15 Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 1242 (1996; Rev Mar 1998) Intermediate Metal  
Conduit

UL 1971 (1995; Rev thru Apr 1999) Signaling  
Devices for the Hearing Impaired

UL 228	(1997; Rev Jan 1999) Door Closers-Holders, With or Without Integral Smoke Detectors
UL 268	(1996; Rev thru Jan 1999) Smoke Detectors for Fire Protective Signaling Systems
UL 268A	(1998) Smoke Detectors for Duct Application
UL 38	(1999) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems
UL 464	(1996; Rev thru May 1999) Audible Signal Appliances
UL 521	(1999) Heat Detectors for Fire Protective Signaling Systems
UL 6	(1997) Rigid Metal Conduit
UL 632	(2000) Electrically-Actuated Transmitters
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 864	(1996; Rev thru Mar 1999) Control Units for Fire Protective Signaling Systems

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

#### Fire Alarm Reporting System

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm

Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

#### SD-03 Product Data

##### Storage Batteries

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

##### Voltage Drop

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

##### Special Tools and Spare Parts

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

##### Technical Data and Computer Software; G

Technical data which relates to computer software.

##### Training

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

##### Testing

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 3 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

#### SD-06 Test Reports

### Testing

Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. The Contractor shall include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

### SD-07 Certificates

#### Equipment

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

#### Qualifications

Proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

### SD-10 Operation and Maintenance Data

#### Technical Data and Computer Software

Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

## 1.3 GENERAL REQUIREMENTS

### 1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

#### 1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

#### 1.3.3 Keys and Locks

Locks shall be keyed alike. Four keys for the system shall be provided.

#### 1.3.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

#### 1.3.5 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

#### 1.3.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

#### 1.3.7 Qualifications

##### 1.3.7.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

##### 1.3.7.2 Installer

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 3 Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and



terminate fire alarm devices, cabinets and panels. An electrician or NICET Level 1 Fire Alarm Technician shall install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

#### 1.4 SYSTEM DESIGN

##### 1.4.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm reporting system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to initiating device circuits (IDC), Style D, to signal line circuits (SLC), Style 6, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all IDC, NAC and SLC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

- a. Sufficient memory to perform as specified and as shown for addressable system.
- b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors
- c. Capability of each addressable device being individually disabled or enabled from the panel.
- d. Each SLC shall be sized to provide 40 percent addressable expansion without hardware modifications to the panel.

##### 1.4.2 Operational Features

The system shall have the following operating features:

- a. Monitor electrical supervision of IDC, SLC, and NAC. Smoke detectors shall have combined alarm initiating and power circuits.
- b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit

integrity.

- c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.
- d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.
- f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.
- g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.
- h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices other than smoke detectors shall be programmed without confirmation or verification.
- i. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided.
- j. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then

automatically reset the alarm, without activating the transmitter during the entire process.

- k. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.
- l. The fire alarm control panel shall monitor and control the fire sprinkler system, or other fire protection extinguishing system.
- m. The control panel and field panels shall be software reprogrammable to enable expansion or modification of the system without replacement of hardware or firmware. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.
- n. Zones for IDC and NAC shall be arranged as indicated on the contract drawings.

#### 1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

- a. Transmission of a signal over the station radio fire reporting system. The signal shall be common for any device.
- b. Visual indications of the alarmed devices on the fire alarm control panel display and on the remote audible/visual display.
- c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ANSI S3.41.
- d. Closure of doors held open by electromagnetic devices.
- e. Operation of the smoke control system.
- f. Deactivation of the air handling units throughout the building.

#### 1.4.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

#### 1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

#### 1.4.6 Interface With other Equipment

Interfacing components shall be furnished as required to connect to subsystems or devices which interact with the fire alarm system, such as supervisory or alarm contacts in suppression systems, interfaces door releases, etc.

#### 1.5 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

- (1) Identification of programmable portions of system equipment and capabilities.
- (2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
- (3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.
- (4) Description of Fire Alarm Control Panel equipment operation.
- (5) Description of auxiliary and remote equipment operations.
- (6) Library of application software.
- (7) Operation and maintenance manuals as specified in SD-19 of the Submittals paragraph.

#### 1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

### PART 2 PRODUCTS

#### 2.1 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory

functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Each IDC shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other devices. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red.

#### 2.1.1 Remote System Audible/Visual Display

Audible appliance shall have a minimum sound level output rating of 85 dBA at 10 feet and operate in conjunction with the panel integral display. The audible device shall be silenced by a system silence switch on the remote system. The audible device shall be silenced by the system silence switch located at the remote location, but shall not extinguish the visual indication. The remote LED/LCD visual display shall provide identification, consisting of the word description and id number for each device as displayed on the control panel. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Remote Display" shall be provided at the remote audible/visual display. The remote visual appliance located with the audible appliance shall not be extinguished until the trouble or alarm has been cleared.

#### 2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

#### 2.1.3 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

#### 2.1.4 Addressable Control Module

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled.

#### 2.1.5 Addressable Initiating Device Circuits Module

The initiating device being monitored shall be configured as a Style D initiating device circuits. The system shall be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling. The module shall be UL listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull stations with a monitor module in a common backbox are not required to have an LED. Existing fire alarm system initiating device circuits shall be connected to a single module to power and supervise the circuit.

### 2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located in a separate battery cabinet. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the fire alarm control panel.

### 2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

## 2.4 ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on surface or flush-mounted outlet boxes. Manual stations shall be mounted at 48 inches. Stations shall be double action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

## 2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated.

### 2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by combination fixed temperature and rate-of-rise principle. Heat detector spacing shall be rated in accordance with UL 521. Detectors located in areas subject to moisture shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

#### 2.5.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only. The UL 521 test rating for the fixed temperature portion shall be 135 degrees F. The UL 521 test rating for the Rate-of-Rise detectors shall be rated for 50 by 50 ft.

### 2.5.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

#### 2.5.2.1 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

#### 2.5.2.2 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 100 and 4000 fpm. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 6 feet and those mounted below 6 feet that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions specified in Section 15950A HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

### 2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be



painted red. Recessed audible appliances shall be installed with a grill that is painted red.

#### 2.6.1 Alarm Bells

Bells shall be surface mounted with the matching mounting back box surface mounted or recessed. Bells shall be suitable for use in an electrically supervised circuit. Bells shall be the underdome type producing a minimum output rating of 85 dBA at 10 feet. Bells used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles. Single stroke, electrically operated, supervised, solenoid bells shall be used for coded applications.

#### 2.6.2 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box surface mounted or recessed, single or double projector, vibrating type suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 85 dBA at 10 feet. Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

#### 2.6.3 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 75 candela. Strobe shall be surface mounted.

#### 2.6.4 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

#### 2.6.5 Voice Evacuation System

The voice evacuation system shall provide for one-way voice communications, routing and pre-amplification of digital alarm tones and voice (digital and analog) messages. The system shall be zoned for messages (Custom and prerecorded) and tones as indicated on the drawings. The following electronic tones shall be available from the amplifier: Slow Whoop, High/Low, Horn, Chime, Beep, Stutter, Wail and Bell. The system shall have a microphone and allow for general paging within the space. Operation shall be either manually from a control switch or automatically from the fire alarm control panel. Reset shall be accomplished by the fire alarm control panel during panel reset.

## 2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

### 2.7.1 Electromagnetic Door Hold-Open Devices

Devices shall be attached to the walls unless otherwise indicated. Devices shall comply with the appropriate requirements of UL 228. Devices shall operate on 24 Volt dc power. Compatible magnetic component shall be attached to the door. Under normal conditions, the magnets shall attract and hold the doors open. When magnets are de-energized, they shall release the doors. Magnets shall have a holding force of 25 pounds. Devices shall be UL or FM approved. Housing for devices shall be brushed aluminum or stainless steel. Operation shall be fail safe with no moving parts. Electromagnetic door hold-open devices shall not be required to be held open during building power failure.

### 2.7.2 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

### 2.7.3 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be copper cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No. 16 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 5 addressable systems.

### 2.7.4 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

## 2.8 TRANSMITTERS

### 2.8.1 Radio Alarm Transmitters

Transmitters shall be Monaco and compatible with proprietary supervising station receiving equipment. Each radio alarm transmitter shall be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transmitters shall be provided in accordance with applicable portions of

NFPA 72, NFPA 1221, and 47 CFR 15. Transmitter electronics module shall be contained within the physical housing as an integral, removable assembly. The proprietary supervising station receiving equipment is Monaco and the transceiver shall be fully compatible with this equipment. At the contractors option, and if UL listed, the transmitter may be housed in the same panel as the fire alarm control panel.

#### 2.8.1.1 Transmitter Power Supply

Each radio alarm transmitter shall be powered by a combination of locally available 120-volt ac power and a sealed, lead-calcium battery.

a. Operation: Each transmitter shall operate from 120-volt ac power. In the event of 120-volt ac power loss, the transmitter shall automatically switch to battery operation. Switchover shall be accomplished with no interruption of protective service, and shall automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic.

b. Battery Power: Transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 72 hours and be capable of transmitting alarms during that period.

#### 2.8.1.2 Radio Alarm Transmitter Housing

Transmitter housing shall be NEMA Type 1. The housing shall contain a lock that is keyed identical to radio alarm transmitter housings on the base. Radio alarm transmitter housing shall be factory painted with a suitable priming coat and not less than two coats of a hard, durable weatherproof enamel.

#### 2.8.1.3 Antenna

The Contractor shall provide omnidirectional, coaxial, halfwave dipole antennas for radio alarm transmitters with a driving point impedance to match transmitter output. The antenna and antenna mounts shall be corrosion resistant and designed to withstand wind velocities of 100 mph. Antennas shall not be mounted to any portion of the building roofing system.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

All work shall be installed as shown, and in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

##### 3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch

circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

#### 3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

Initiating and indicating circuits shall be installed in separate conduits.

#### 3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 12 inches nor more than 78 inches above the finished floor. Manually operable controls shall be between 36 and 42 inches above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

#### 3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 12 inches from any part of any lighting fixture. Detectors shall be located at least 3 feet from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 3 feet, sway bracing shall be provided. Detectors installed in concealed locations (above ceiling, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location.

#### 3.1.5 Notification Appliances

Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

### 3.1.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

### 3.1.7 Addressable Initiating Device Circuits Module

The initiating device circuits module shall be used to connect supervised conventional initiating devices (water flow switches, water pressure switches, manual fire alarm stations, high/low air pressure switches, and tamper switches). The module shall mount in an electrical box adjacent to or connected to the device it is monitoring and shall be capable of Style B supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on style B lines. Addressable initiating device circuits modules shall monitor only one initiating device each. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as specified in Section 13930A WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

### 3.1.8 Addressable Control Module

Addressable and control modules shall be installed in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall be mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. All interconnecting wires shall be supervised unless an open circuit or short circuit abnormal condition does not affect the required operation of the fire alarm system. If control modules are used as interfaces to other systems, such as HVAC or elevator control, they shall be within the control panel or immediately adjacent to it. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as specified in Section 13930A WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

## 3.2 OVERVOLTAGE AND SURGE PROTECTION

### 3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

### 3.2.2 Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

### 3.2.3 Signal Line Circuit Surge Protection

All SLC cables/conductors, except fiber optics, shall have surge protection/isolation circuits installed at each point where it exits or enters a building. The circuit shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector/isolator shall be rated to protect the equipment.

### 3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

### 3.4 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

#### 3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

#### 3.4.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

- a. Test of each function of the control panel.

- b. Test of each circuit in both trouble and normal modes.
- c. Tests of each alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault
- k. Short circuit faults
- l. Stray voltage
- m. Loop resistance

### 3.5 TRAINING

Training course shall be provided for the operations and maintenance staff.

The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation and maintenance shall consist of two (2) training sessions of four (4) hours each, separated by at least one week, and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system.

-- End of Section --

## SECTION 13920A

FIRE PUMPS  
12/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36

ASTM A 183 (1998) Carbon Steel Track Bolts and Nuts

ASTM A 193/A 193M (2001a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 194/A 194M (2001) Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service or Both

ASTM A 449 (2000) Quenched and Tempered Steel Bolts and Studs

ASTM A 47/A 47M (1999) Ferritic Malleable Iron Castings

ASTM A 53/A 53M (2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 536 (1984; R 1999e1) Ductile Iron Castings

ASTM A 563 (2000) Carbon and Alloy Steel Nuts

ASTM A 563M (2000) Carbon and Alloy Steel Nuts (Metric)

ASTM A 795 (2000) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

ASTM B 135 (2000) Seamless Brass Tube

ASTM B 135M (1996) Seamless Brass Tube (Metric)

ASTM B 42 (1998) Seamless Copper Pipe, Standard Sizes

ASTM B 62 (1993) Composition Bronze or Ounce Metal



## Castings

ASTM B 75	(1999) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 3308	(1997) PTFE Resin Skived Tape
ASTM F 436	(2000) Hardened Steel Washers
ASTM F 436M	(1993) Hardened Steel Washers (Metric)

## AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1992; Addenda B301a - 1999) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C500	(1993; C500a) Metal-Seated Gate Valves for Water Supply Service
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA EWW	(1999) Standard Methods for the Examination of Water and Wastewater
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

## ASME INTERNATIONAL (ASME)

ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
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## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1963	(1998) Fire Hose Connections
NFPA 20	(1999) Installation of Centrifugal Fire Pumps
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances

NFPA 37 (1998) Installation and Use of Stationary  
Combustion Engines and Gas Turbines

NFPA 70 (1999) National Electrical Code

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES  
(NICET)

NICET 1014-7 (1995) Program Detail Manual for  
Certification in the Field of Fire  
Protection Engineering Technology (Field  
Code 003) Subfield of Automatic Sprinkler  
System Layout

UNDERWRITERS LABORATORIES (UL)

UL 1247 (1995; Rev thru May 1997) Diesel Engines  
for Driving Centrifugal Fire Pumps

UL 142 (1993; Rev Jul 1998) Steel Aboveground  
Tanks for Flammable and Combustible Liquids

UL 262 (1994; Rev thru Dec 1998) Gate Valves for  
Fire-Protection Service

UL 448 ((1994; Rev thru May 1999) Pumps for  
Fire-Protection Service

UL 80 (1996) Steel Inside Tanks for Oil-Burner  
Fuel

UL Fire Prot Dir (1999) Fire Protection Equipment Directory

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.399 Frequency Devices

## 1.2 GENERAL REQUIREMENTS

Except as modified in this Section or on the drawings, fire pumps shall be installed in conformance with NFPA 20, including all recommendations and advisory portions, which shall be considered mandatory. All reference to the authority having jurisdiction shall be interpreted to mean the Contracting Officer.

## 1.3 SEQUENCE OF OPERATION

### 1.3.1 Primary Fire Pump

Primary fire pump shall automatically operate when the pressure drops to 110 psi. The fire pump shall automatically stop operating when the system pressure reaches 125 psi and after the fire pump has operated for the minimum pump run time specified herein.

#### 1.3.1.1 Pressure Maintenance Pump

Pressure maintenance pump shall operate when the system pressure drops to 115 psi. Pump shall automatically stop when the system pressure reaches 125 psi and after the pump has operated for the minimum pump run time specified herein.

#### 1.3.2 Safety Requirements

Coupling, rotating parts, gears, projecting equipment, etc. shall be fully enclosed or properly guarded so as to prevent possible injury to persons that come in close proximity of the equipment. The Contractor shall conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams.

#### 1.4 COORDINATION OF TRADES

Tank supports, piping offsets, fittings, and any other accessories required shall be furnished as specified to provide a complete installation and to eliminate interference with other construction.

#### 1.5 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed with protection from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall be either capped or plugged until installed.

#### 1.6 FIELD MEASUREMENTS

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

#### 1.7 SUBMITTALS

Indicate submittal classification in the blank space following the name of the item requiring the submittal by using "G" when the submittal requires Government approval. Submittals not classified as "G" will show on the submittal register as "Information Only". For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

## Installation Requirements; G

Three copies of the Fire Pump Installation Drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping, drawn to a scale of not less than 1/2 inch = 1 foot. Drawings shall indicate equipment, piping, and associated pump equipment to scale. All clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment shall be indicated. Drawings shall include a legend identifying all symbols, nomenclatures, and abbreviations. Drawings shall indicate a complete piping and equipment layout including elevations and/or section views of the following:

- a. Fire pumps, controllers, piping, valves, and associated equipment.
- b. Sensing line for each pump including the pressure maintenance pump.
- c. Engine fuel system for diesel driven pumps.
- d. Engine cooling system for diesel driven pumps.
- e. Pipe hangers and sway bracing including support for diesel muffler and exhaust piping.
- f. Restraint of underground water main at entry-point or entry-and exit-points to the building including details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.
- g. A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.
- h. A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

## As-Built Drawings; G

As-built drawings, no later than 14 days after completion of the Final Tests. The Fire Pump Installation Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

## SD-03 Product Data

## Fire Pump Installation Related Submittals; G

A list of the Fire Pump Installation Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist and the Manufacturer's Representative.

## Installation Requirements; G

Manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:

- a. Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.
- b. Pressure maintenance pump and controller.
- c. Piping components.
- d. Valves, including gate, check, globe and relief valves.
- e. Gauges.
- f. Hose valve manifold test header and hose valves.
- g. Flow meter.
- h. Restrictive orifice union.
- i. Associated devices and equipment.

## Spare Parts;

Spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

## Preliminary Test; G

Proposed procedures for Preliminary Tests, at least 14 days prior to the proposed start of the tests.

Proposed date and time to begin Preliminary Tests, submitted with the Preliminary Tests Procedures.

## System Diagrams; G

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment,

pipng, and storage units, and typed condensed sequence of operation, wiring and control diagrams, and operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

Fire Protection Specialist; G

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings.

Manufacturer's Representative; G

The name and documentation of certification of the proposed Manufacturer's Representative, concurrent with submittal of the Fire Protection Specialist Qualifications.

Field Training; G

Proposed schedule for field training submitted at least 14 days prior to the start of related training.

Final Acceptance Test; G

Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests.

SD-06 Test Reports

Preliminary Test; G

Three copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist and the Manufacturer's Representative.

Final Acceptance Test; G

Three copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed

by the Fire Protection Specialist and the Manufacturer's Representative. Test reports in booklet form (each copy furnished in a properly labeled three ring binder) showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches.

The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report.

#### SD-07 Certificates

Fire Protection Specialist; G

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the fire pump installation is in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

#### SD-10 Operation and Maintenance Data

Fire Pumps;

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

### 1.8 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level IV Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.



### 1.9 MANUFACTURER'S REPRESENTATIVE

Work specified in this section shall be performed under the supervision of and certified by a representative of the fire pump manufacturer. The Manufacturer's Representative shall be regularly engaged in the installation of the type and complexity of fire pump(s) specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

### 1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### 2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number. Pumps and motors shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.

### 2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

### 2.4 UNDERGROUND PIPING COMPONENTS

#### 2.4.1 Pipe and Fittings

Underground piping and piping under the building slab shall be ductile iron with a rated working pressure of 175 psi conforming to AWWA C151, with cement mortar lining conforming to AWWA C104. Piping more than 5 feet

outside the building walls shall comply with Section 02510A WATER DISTRIBUTION SYSTEM.

#### 2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111.

#### 2.4.3 Valves and Valve Boxes

Valves shall be gate valves conforming to AWWA C500 or UL 262. Valves shall have cast-iron body and bronze trim. Valve shall open by counterclockwise rotation. Except for post indicator valves, all underground valves shall be provided with an adjustable cast-iron or ductile iron valve box of a size suitable for the valve on which the box is to be used, but not less than 5.25 inches in diameter. The box shall be coated with bituminous coating. A cast-iron or ductile-iron cover with the word "WATER" cast on the cover shall be provided for each box.

#### 2.4.4 Buried Utility Warning and Identification Tape

Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping shall be provided for all buried piping. Tape shall be detectable by an electronic detection instrument. Tape shall be color-coded for the utility involved and imprinted in bold black letters continuously and repeatedly over the entire tape length. Warning and identification shall be "CAUTION BURIED WATER PIPING BELOW" or similar wording. Code and lettering shall be permanent and unaffected by moisture and other substances contained in the trench backfill material. Tape shall be buried at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavement.

### 2.5 ABOVEGROUND PIPING COMPONENTS

#### 2.5.1 Pipe Sizes 2.5 inches and Larger

##### 2.5.1.1 Pipe

Piping shall be ASTM A 795, Weight Class STD (Standard), Schedule 40 (except for Schedule 30 for pipe sizes 8 inches and greater in diameter), Type E or Type S, Grade A; black steel pipe. Steel pipe shall be joined by means of flanges welded to the pipe or mechanical grooved joints only. Piping shall not be jointed by welding or weld fittings. Suction piping shall be galvanized on the inside per NFPA 20.

##### 2.5.1.2 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts

and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

#### 2.5.1.3 Flanges

Flanges shall be ASME B16.5, Class 150 flanges. Flanges shall be provided at valves, connections to equipment, and where indicated.

#### 2.5.1.4 Gaskets

Gaskets shall be AWWA C111, cloth inserted red rubber gaskets.

#### 2.5.1.5 Bolts

Bolts shall be ASTM A 449, Type 1 or 2. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

#### 2.5.1.6 Nuts

Nuts shall be ASTM A 193/A 193M, Grade 5.

#### 2.5.1.7 Washers

Washers shall meet the requirements of ASTM F 436. Flat circular washers shall be provided under all bolt heads and nuts.

### 2.5.2 Piping Sizes 2 inches and Smaller

#### 2.5.2.1 Steel Pipe

Steel piping shall be ASTM A 795, Weight Class STD (Standard), Schedule 40, Type E or Type S, Grade A, zinc-coated steel pipe with threaded end connections. Fittings shall be ASME B16.39, Class 150, zinc-coated threaded fittings. Unions shall be ASME B16.39, Class 150, zinc-coated unions.

#### 2.5.2.2 Copper Tubing

Copper tubing shall be ASTM B 88, Type L or K, soft annealed. Fittings shall be ASME B16.26, flared joint fittings. Pipe nipples shall be ASTM B 42 copper pipe with threaded end connections.

### 2.5.3 Pipe Hangers and Supports

Pipe hangers and support shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b and shall be the adjustable type. Finish of rods, nuts, washers, hangers, and supports shall be zinc-plated after fabrication.

### 2.5.4 Valves

Valves shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire protection service. Valves shall have flange or threaded end connections.

#### 2.5.4.1 Gate Valves and Control Valves

Gate valves and control valves shall be outside screw and yoke (O.S.&Y.) type which open by counterclockwise rotation. Butterfly-type control valves are not permitted.

#### 2.5.4.2 Tamper Switch

The suction control valves, the discharge control valves, valves to test header and flow meter, and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

#### 2.5.4.3 Check Valve

Check valve shall be clear open, swing type check valve with flange or threaded inspection plate.

#### 2.5.4.4 Relief Valve

Relief valve shall be pilot operated type conforming to NFPA 20. A means of detecting water motion in the relief lines shall be provided where the discharge is not visible within the pump house.

#### 2.5.4.5 Circulating Relief Valve

An adjustable circulating relief valve shall be provided for each fire pump in accordance with NFPA 20.

#### 2.5.4.6 Suction Pressure Regulating Valve

Suction pressure regulating valve shall be FM approved FM P7825a and FM P7825b. Suction pressure shall be monitored through a pressure line to the controlling mechanism of the regulating valve. Valve shall be arranged in accordance with the manufacturer's recommendations.

### 2.6 FIRE PUMP

Fire pump shall be electric motor driven. Each pump capacity shall be rated at 500 gpm with a rated net pressure of 100 psi. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be centrifugal horizontal split case, end-suction or in-line fire pump. Horizontal pump shall be equipped with automatic air release devices. The maximum rated pump speed shall be 2100 rpm when driving the pump at rated capacity. Pump shall conform to the requirements of UL 448. Fire pump discharge and suction gauges shall be oil-filled type.

### 2.7 ELECTRIC MOTOR DRIVER

Motor shall conform to NEMA MG 1 and be marked as complying with NEMA Design B standards. Motor horsepower shall be of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. The motor and fire pump controller

shall be fully compatible.

## 2.8 FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b for fire pump service. Pump shall be arranged for automatic start and stop, and manual push-button stop. Automatic stopping shall be accomplished only after all starting causes have returned to normal and after a minimum pump run time has elapsed. Controllers shall be completely terminally wired, ready for field connections, and mounted in a NEMA Type 4 watertight and dust tight enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Controller shall be provided with voltage surge arresters installed per NFPA 20. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures falls below 40 degrees F The controller shall be factory-equipped with a heater operated by thermostat to prevent moisture in the cabinet.

### 2.8.1 Controller for Electric Motor Driven Fire Pump

Controller shall be electronic soft start starting type. Controller shall be designed for 50HP HP at 480 volts. Controller and transfer switch shall have a short circuit rating of 42,000 amps r.m.s. symmetrical at 480 volts a.c. An automatic transfer switch (ATS) shall be provided for each fire pump. The ATS shall comply with NFPA 20 and shall be specifically listed for fire pump service. The ATS shall transfer source of power to the alternate source upon loss of normal power. Controller shall monitor pump running, loss of a phase or line power, phase reversal, low reservoir and pump room temperature. Alarms shall be individually displayed in front of panel by lighting of visual lamps. Each lamp shall be labeled with rigid etched plastic labels. Controller shall be equipped with terminals for remote monitoring of pump running, pump power supply trouble (loss of power or phase and phase reversal), and pump room trouble (pump room temperature and low reservoir level), and for remote start. Limited service fire pump controllers are not permitted, except for fire pumps driven by electric motors rated less than 15 hp. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour spring wound back-up. The pressure recorder shall provide a readout of the system pressure from 0 to 15 hp, time, and date. Controller shall require the pumps to run for ten minutes for pumps with driver motors under 200 horsepower and for 15 minutes for pumps with motors 200 horsepower and greater, prior to automatic shutdown. The controller shall be equipped with an externally operable isolating switch which manually operates the motor circuit. Means shall be provided in the controller for measuring current for all motor circuit conductors.

## 2.9 PRESSURE SENSING LINE

A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in

accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line shall be 1/2 inch H58 brass tubing complying with ASTM B 135. The sensing line shall be equipped with two restrictive orifice unions each. Restrictive orifice unions shall be ground-face unions with brass restricted diaphragms drilled for a 3/32 inch. Restrictive orifice unions shall be mounted in the horizontal position, not less than 5 feet apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 1/2 inch globe valves and 1/4 inch gauge connection tee arranged per NFPA 20. One of the test connections shall be equipped with a 0 to 300 psi water oil-filled gauge. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

## 2.10 PRESSURE MAINTENANCE PUMP

Pressure maintenance pump shall be electric motor driven, horizontal shaft or in-line vertical shaft, centrifugal type with a rated discharge of 10 gpm at 125 psig. Pump shall draft from the suction supply side of the suction pipe gate valve of the fire pump and shall discharge into the system at the downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type shall be provided in the maintenance pump discharge and suction piping. Oil-filled water pressure gauge and approved check valve in the maintenance pump discharge piping shall be provided. Check valve shall be swing type with removable inspection plate.

### 2.10.1 Pressure Maintenance Pump Controller

Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line shall be provided connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line shall conform to paragraph, PRESSURE SENSING LINE. The sensing line shall be completely separate from the fire pump sensing lines. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for 2 minutes.

## 2.11 PUMP BASE PLATE AND PAD

A common base plate shall be provided for each horizontal-shaft fire pump for mounting pump and driver unit. The base plate shall be constructed of cast iron with raised lip tapped for drainage or welded steel shapes with suitable drainage. Each base plate for the horizontal fire pumps shall be provided with a 1 inch galvanized steel drain line piped to the nearest floor drain. For vertical shaft pumps, pump head shall be provided with a cast-iron base plate and shall serve as the sole plate for mounting the discharge head assembly. Pump units and bases shall be mounted on a raised 4 \_\_\_ or 6 inches reinforced concrete pad that is an integral part of the reinforced concrete floor.

## 2.12 HOSE VALVE MANIFOLD TEST HEADER

Hose valve test header shall be connected by ASME B16.5, Class 150 flange inlet connection. Hose valves shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825b bronze hose gate valves with 2.5 inches American National Fire Hose Connection Screw Standard Threads (NH) per NFPA 1963. The number of valves shall be per NFPA 20. Each hose valve shall be equipped with a cap and chain, and located no more than 3 feet and no less than 2 feet above grade.

## 2.13 FLOW METER

Meter shall be UL listed UL Fire Prot Dir or FM approved FM P7825a and FM P7825bas flow meters for fire pump installation with direct flow readout device. Flow meter shall be capable of metering any waterflow quantities between 50 percent and 150 percent of the rated flow of the pumps. The flow meter shall be arranged in accordance with Figure A-2-14.2.1 of NFPA 20.

The meter throttle valve and the meter control valves shall be O.S.&Y. valves. Automatic air release shall be provided if flow meter test discharge is piped to the pump suction and forms a closed-loop meter arrangement as defined in Figure A-2-14.2.1 of NFPA 20.

## 2.14 PIPE SLEEVE

A pipe sleeve shall be provided at each location where piping passes through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Sleeves shall be grouted in position during construction. Sleeve shall be of sufficient length to pass through the entire thickness of the wall, ceilings, roofs and floors. The space between the exterior surface of the pipe and the interior surface of the sleeve shall be firmly packed with mineral wool insulation and caulk at both ends with plastic waterproof cement which will dry to a firm but pliable mass, or with a segmented elastomeric seal. Where pipes pass through fire walls or fire floors, a fire seal shall be provided between the pipe and the sleeve in accordance with Section 07840A FIRESTOPPING. Sleeves in masonry and concrete walls, ceiling, roofs and floors shall be hot-dip galvanized steel, ductile-iron, or cast-iron. Other sleeves shall be galvanized steel sheet pipe not less than 0.90 psf.

## 2.15 ESCUTCHEON (WALL) PLATES

Escutcheon plates shall be one-piece or split-hinge type metal plates and shall be provided for piping passing through floors, walls, and ceiling in exposed areas. In finished areas, plates shall be polished stainless steel or chromium-plated finish on copper alloy. In unfinished areas, plates shall have painted finish. Plates shall be secured in position.

## 2.16 DISINFECTING MATERIALS

### 2.16.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

### 2.16.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

### 2.17 PREFABRICATED FIRE PUMP BUILDING

Furnish and install a complete pre-fabricated fire pump building containing all components specified in Section 13920A and listed herein, assembled and tested by a single manufacturer. Individual components shall be those specified in the documents. ETL third party total certification and UL listing shall be provided. The building shall be built in accordance with NFPA 20, 70 and 72. Building shall meet OSHA and Federal Regulation 29 CFR 1910.399. Provide factory test and test results shall be copied to the engineer. Unit shall be pre-wired and shall be designed to accept one normal power connection and one emergency power connection. Unit shall be pre-wired for and coordinated with the Fire Alarm System specified in Section 13581A. The building shall be 9 feet wide x 16 feet long x 10 feet high clear dimensions complete with all necessary component parts, to form a complete turn-key building system. Piping inlet and outlet locations are indicated on the plans. Coordinate all connections with all trades/contractors involved prior to the installation. Coordinate fault current rating with Electrical Contractor.

#### 2.17.1 Building Construction

The building shall be constructed on an I-Beam structural steel skid. All interior equipment and system components shall be supported as indicated in the documents. The building shall be designed in accordance with the applicable sections of the latest edition of the AISC "Specifications for the Design, Fabrications, and Erection of Structural Steel for Buildings" and the AISI "Specifications of the Design and Light Gauge Cold-Formed Steel Structural Members." Design for the following loads, in addition to the stationary weight of the building. Reduction of loads due to tributary loaded areas will not be permitted.

1. The vertical Live load of the building shall not be less than 40 pounds per square foot applied on the horizontal projection of the roof.

2. The horizontal Wind Load of the building shall not be less than 110 mph and shall be distributed and applied in accordance with the applicable edition of the Metal Building Manufacturers Association (MBMA) publication title "Low Rise Building Systems Manual". All combining and distributing of auxiliary equipment loads imposed on the building system shall be done in accordance with the applicable section of the MBMA publication titled "Low Rise Building Systems Manual". Provide the engineer with complete design certification signed and sealed by a registered structural engineer.

#### 2.17.2 Panel Roof System

Provide 1-1/2" pitch interlocking panel roof system. Roof panels shall be attached to the wall cap through factory punched holes with #14 corrosion-resistant fasteners. The roof system shall include a gutter and downspout system at each sidewall and matching rake trim at the building endwalls. All gutters and trim shall be galvanized steel pre-painted



Arctic White. Transmission of horizontal wind loads across the building shall be made through the panel roof system and no separate roof or wall diagonal bracing shall be required. When required for proper transmission of lateral wind loads, structural frame wind bents shall be installed. Wind bents shall consist of a bolted column and rafter assembly of steel conforming to ASTM A 36 specifications.

#### 2.17.2.1 Roof Panels

Roof panels shall be supplied in a single continuous length from eave line to ridge line and shall be designed to tightly interlock so that no fasteners are required at intermediate points along the panel side laps. Panels shall be 16-inches wide with a smooth surface between the interlocking side ribs. The interlocking ribs shall be a minimum 3" high, and shall be turned upward. All roof panels shall be factory punched for connection at the eave line of the building. Do not provide penetrations through the roof covering except at eave lines, ridge lines, and roof accessory openings such as skylights and ventilators. Roof panels shall be minimum 24 gauge steel coated on both sides with a coating of corrosion-resistant aluminum-zinc alloy conforming to ASTM A-792 specification with coating conforming to AZ55(55%) standard by continuous hot dipping process. Coating weight shall be a minimum of 0.32 oz. of aluminum-zinc alloy per square foot of coated sheet equivalent to about 0.75 mil thickness on each side. Minimum yield strength of the panel material shall be 50,000 psi. Roof panels shall receive a factory, roller applied, paint coating having an exterior coating thickness of 0.8 to 1.2 mils of dry film thickness. The color coating shall carry a low fire hazard rating equal to a Class 1 material as defined by Factory Mutual. The panel coating shall have achieved a Flame Spread Index of 235 or less and a Fuel Contributed Index of 100 or less when tested in accordance with ASTM E-85 test procedures. The finish coat shall be a white polyester formulation that will meet the following performance standards after 10 years continuous exposure in "normal" atmospheric conditions not containing corrosive fumes such as chemicals or salt spray.

1. Panels shall show no evidence of blistering, peeling, or chipping.
2. Panels shall not show surface chalking in excess of the No. 6 rating D659-44 as established by the American Society of Materials (ASTM).
3. Panels, after cleaning, shall not show color change in excess of five (5) units when measured in accordance with the ASTM-D-2244-68 standard.

#### 2.17.3 Roof Insulation

Roof insulation shall consist of 48" wide, 4" thick, .6# density fiberglass faced on its exposed side with an embossed white vinyl facing. The faced insulation material shall have a UL Flame Spread Rating of 25 when tested in accordance with UP 723 or ASTM E-84 procedures. Insulation shall be supported at the roof line by means of mechanical clips spaced on maximum 4-foot centers and shall be sealed by means of a 2" side tab on the facing.

The "U" value through the insulated roof shall be a maximum of 0.08 BTU's per square foot when measured in accordance with the "Zone Method" contained in ASHRAE "Handbook of Fundamentals", 1981 edition.

#### 2.17.4 Exterior Wall Panels

Exterior wall panels shall be a single continuous length from the base channel to the roof line of the building at the sidewalls and end walls of the building except where interrupted by wall openings. Wall panels shall be 16" wide and 3" deep inward turned interlocking side ribs. Wall panels shall contain two (2) 3/4" deep by 3-1/8" wide fluted recesses, each starting 2-7/16" from the panel edge. Wall panels shall be fastened internally to the base channel and eave cap of the building with 3/8" diameter electro-galvanized machine bolts placed within the panel interlock. The panels shall be minimum 24 gauge galvanized steel conforming to ASTM A-653 specifications with the galvanized coating conforming to G90 (1-1/4 oz.) standards. Minimum yield strength of panel material shall be 40,000 psi. Panel material shall be embossed with a random pattern pebble embossed of approximately .007 - .008 depth. All exterior surfaces of the galvanized steel wall covering and exterior trim shall receive a factory roller applied, paint coating having an exterior coating thickness of 0.8 to 1.2 mils of dry film thicknesses. The finished coat for wall panels shall be a polyester formulation as selected by the Architect. The wall panel color coating shall carry a low fire hazard rating equal to a Class 1 material as defined by Factory Mutual. The panel coating shall have achieved a Flame Spread Index of 25 or less and a Fuel Contributed Index of 100 or less when tested in accordance with ASTM E-84 test procedures. Exterior color coating shall meet the following performance standards after 10 years continuous exposure in normal atmospheric conditions not containing corrosive fumes such as chemical fumes of salt spray:

1. Panels shall show no evidence of blistering, peeling, or chipping.
2. Panels shall not show surface chalking in excess of the No. 8 rating D659-44 as established by the American Society of Testing Materials (ASTM).
3. Panels, after cleaning, shall not show color change in excess of five (5) units when measured in accordance with the ASTM-2244-68 standard.

#### 2.17.5 Interior of Walls

The interior of the building walls shall be lined with a factory-assembled insulated metal liner having no exposed fasteners except at the base, ceiling, and accessory trim. Liner panels shall be 16" wide and shall be minimum 25 gauge embossed galvanized steel pre-painted Parchment White. Insulation shall be noncombustible, nominal 7/8" thick, #2 density fiberglass laminated to the liner panel. The liner system shall be furnished with matching base, cover and accessory trim. The void between the exterior wall panel and the lock-in liner shall be insulated with 3" thick unfaced fiberglass insulation. The "U" value of the assembled wall system shall be a maximum of 0.19 BTU's per square foot when measured in accordance with the "Zone Method" contained ASHRAE "Handbook of Fundamentals," 1981 edition.

## 2.17.6 Doors

All doors shall be 1-3/4" thick flush type. Door panels shall be minimum 20 gauge galvanized steel reinforced by lamination to a honeycomb core enclosed with a continuous steel perimeter channel. The hinge edge channel shall be minimum 7 gauge and the lock edge channel shall be minimum 16 gauge. Door panels shall be projection welded to the perimeter channels on maximum 5" centers. Door frames shall be 4-3/4" deep double rabbeted type of minimum 16 gauge galvanized steel. Doors and frames shall be factory painted with one coat of baked-on primer. All doors shall be preassembled in their frames and hardware installed and tested prior to shipment. Field installation of the door unit shall not require any frame assembly, door handling, or hardware installation.

## 2.17.7 Door Hardware

Door hardware shall consist of:

1. Three (3) 4-1/4 x 4" standard weight plain bearing per ANSI A5311, 6340 satin stainless finish with non-rising pins.
2. Three (3) 11/16" wide x 5/8" high extruded aluminum threshold (exterior doors only).
3. Silicone rubber weather-stripping measuring 1/4 x 3/8" (exterior doors only).

Mortise lockset per ANSI A156.13, Series 1000, Grade 1, Function F13, 626 satin chrome.

## 2.17.8 Trim

The building manufacturer shall provide all necessary framing and connectors to incorporate any wall openings. All trim and flashings required to make weather-tight shall be provided. Louvers shall be minimum 26 gauge, G90 galvanized steel general purpose type with 50% free area per overall louver size. Finish shall match exterior panels. Provide #8 insect screens.

## 2.17.9 Options

Installed options shall include the following; completely wired, tested, and operational:

1. One (1) unit heater with thermostat (adequately sized to prevent freezing).
2. One (1) motorized damper.
3. One (1) 16" exhaust fan, damper and thermostat (adequately sized for heat removal).
4. Two (2) 80 Watt fluorescent vapor tight lights and switches.

5. One (1) Lighting panel box with 7-1/2 kVA transformer.
6. Six (6) 15-amp single pole circuit breakers.
7. One (1) exterior walllighter high pressure sodium wall pack with photocell.
8. One (1) Fire Protection System indicated in the Documents.
9. One (1) service-rated disconnect switch.
10. One (1) battery power interior emergency light.

#### 2.17.10 Warranty and Start-Up

The building and internal components shall be warranted by the building manufacturer. Provide factory-trained service representatives for start-up.

### PART 3 EXECUTION

#### 3.1 FIRE PUMP INSTALLATION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation the fire pump(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

#### 3.2 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the fire pump installation periodically assure that the installation conforms to the contract requirements. The Fire Protection Specialist shall perform a thorough inspection of the fire pump installation, including visual observation of the pump while running shall be conducted. There shall be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems. Inspection shall include piping and equipment clearance, access, supports, and guards. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered. The Fire Protection Specialist shall witness the preliminary and final acceptance tests and, after completion of the inspections and a successful final acceptance test, shall sign test results and certify in writing that the installation the fire pump installation is in accordance with the contract requirements.

#### 3.3 INSTALLATION REQUIREMENTS

Installation, workmanship, fabrication, assembly, erection, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer.

## 3.4 PIPE AND FITTINGS

Piping shall be inspected, tested and approved before burying, covering, or concealing. Fittings shall be provided for changes in direction of piping and for all connections. Changes in piping sizes shall be made using tapered reducing pipe fittings. Bushings shall not be used.

## 3.4.1 Cleaning of Piping

Interior and ends of piping shall be clean and free of any water or foreign material. Piping shall be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of the piping shall be securely closed so that no water or foreign matter will enter the pipes or fittings. Piping shall be inspected before placing in position.

## 3.4.2 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape conforming to ASTM D 3308 and shall be applied to male threads only. Exposed ferrous pipe threads shall be provided with one coat of zinc molybdate primer applied to a minimum of dry film thickness of 1 mil.

## 3.4.3 Pipe Hangers and Supports

Additional hangers and supports shall be provided for concentrated loads in aboveground piping, such as for valves and risers.

## 3.4.3.1 Vertical Piping

Piping shall be supported at each floor, at not more than 10 foot intervals.

## 3.4.3.2 Horizontal Piping

Horizontal piping supports shall be spaced as follows:

MAXIMUM SPACING (FEET)										
Nominal Pipe Size (inches)	1 and Under	1.25	1.5	2	2.5	3	3.5	4	5	6+
Copper Tube	6	7	8							
Steel Pipe	7	8	9	10	11	12	13	14	16	17

## 3.4.4 Underground Piping

Installation of underground piping and fittings shall conform to NFPA 24. Joints shall be anchored in accordance with NFPA 24. Concrete thrust block

shall be provided at elbow where pipe turns up towards floor, and the pipe riser shall be restrained with steel rods from the elbow to the flange above the floor. After installation per NFPA 24, rods and nuts shall be thoroughly cleaned and coated with asphalt or other corrosion-retard material approved by the Contracting Officer. Minimum depth of cover shall be 3 feet.

#### 3.4.5 Grooved Mechanical Joint

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

#### 3.5 ELECTRICAL WORK

Electric motor and controls shall be in accordance with NFPA 20 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment shall be provided in accordance with NFPA 20 and Section 16415A ELECTRICAL WORK, INTERIOR.

#### 3.6 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

#### 3.7 FLUSHING

The fire pump suction and discharge piping shall be flushed at 120 percent of rated capacity of each pump. Where the pump installation consists of more than one pump, the flushing shall be the total quantity of water flowing when all pumps are discharging at 120 percent of their rated capacities. The new pumps may be used to attain the required flushing volume. Flushing operations shall continue until water is clear, but not less than 10 minutes. The Contractor shall submit a signed and dated flushing certificate before requesting field testing.

#### 3.8 FIELD TESTS

##### 3.8.1 Hydrostatic Test

Piping shall be hydrostatically tested at 225 psig for a period of 2-hours, or at least 50 psi in excess of the maximum pressure, when the maximum pressure in the system is in excess of 175 psi.

### 3.8.2 Preliminary Test

The Fire Protection Specialist shall take all readings and measurements. The Manufacturer's Representative, a representative of the fire pump controller manufacturer, and a representative of the diesel engine manufacturer (when supplied) shall witness the complete operational testing of the fire pump and drivers. The fire pump controller manufacturer's representative and the diesel engine manufacturer's representative shall each be an experienced technician employed by the respective manufacturers and capable of demonstrating operation of all features of respective components including trouble alarms and operating features. Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed. Tests shall include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer, if provided. Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections shall be made and the entire preliminary test shall be repeated.

### 3.8.3 Final Acceptance Test

The Fire Protection Specialist shall take all readings and measurements. The Manufacturer's Representative, the fire pump controller manufacturer's representative, and the diesel engine manufacturer's representative (when supplied) shall also witness for the final tests. The Contractor shall be responsible for repairing any damage caused by hose streams or other aspects of the test. The final acceptance test shall include the following:

#### 3.8.3.1 Flow Tests

Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall taken on each phase as part of each flow test for electric-motor driven pumps.

#### 3.8.3.2 Starting Tests

Pumps shall be tested for automatic starting and sequential starting. Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20. Tests of engine-driven pumps shall be divided equally between both set of batteries. The fire pumps shall be operated for a period of a least 10

minutes for each of the starts; except that electric motors over 200 horsepower shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours. Pressure settings that include automatic starting and stopping of the fire pump(s) shall be indicated on an etched plastic placard, attached to the corresponding pump controller.

#### 3.8.3.3 Battery Changeover

Diesel driven fire pumps shall be tested for automatic battery changeover in event of failure of initial battery units.

#### 3.8.3.4 Alarms

All pump alarms, both local and remote, shall be tested. Supervisory alarms for diesel drivers shall be electrically tested for low oil pressure, high engine jacket coolant temperature, shutdown from overspeed, battery failure and battery charger failure.

#### 3.8.3.5 Miscellaneous

Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.

#### 3.8.3.6 Alternate Power Source

On installations with an alternate source of power and an automatic transfer switch, loss of primary power shall be simulated and transfer shall occur while the pump is operating at peak load. Transfer from normal to emergency source and retransfer from emergency to normal source shall not cause opening of overcurrent devices in either line. At least half of the manual and automatic starting operations listed shall be performed with the fire pump connected to the alternate source.

#### 3.8.4 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, the Contractor shall performed corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

#### 3.8.5 Test Equipment

The Contractor shall provide all equipment and instruments necessary to conduct a complete final test, including 2.5 inch diameter hoses, playpipe nozzles, pitot tube gauges, portable digital tachometer, voltage and ampere meters, and calibrated oil-filled water pressure gauges. The Contractor shall provide all necessary supports to safely secure hoses and nozzles during the test. The Contractor shall furnish water for the tests.

#### 3.8.6 Test Documentation

The Manufacturer's Representative shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Fire



Protection Specialist shall record all test results and plot curve of each pump performance during the test. Complete pump acceptance test data of each fire pump shall be recorded. The pump acceptance test data shall be on forms that give the detail pump information such as that which is indicated in Figure A-11-2.6.3(f) of NFPA 20. All test data records shall be submitted in a three ring binder.

### 3.9 DISINFECTION

After all system components are installed including pumps, piping, and other associated work, and all hydrostatic test(s) are successfully completed, thoroughly flush the pumps and all piping to be disinfected with potable water until there is no visible sign of dirt or other residue. and hydrostatic test are successfully completed, each portion of the piping specified in this Section system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

### 3.10 FIELD TRAINING

The Fire Protection Specialist and the Manufacturer's Representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of two (2) 2-hour training sessions of normal working time and shall start after the fire pump installation is functionally complete but prior to the start tests specified herein. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

## SECTION 13930A

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION  
05/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM A 135	(2001) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(20001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 449	(2000) Quenched and Tempered Steel Bolts and Studs
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 563	(2000) Carbon and Alloy Steel Nuts
ASTM A 563M	(2001) Carbon and Alloy Steel Nuts (Metric)
ASTM A 795	(2000) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM B 75	(2002) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 88	(2002) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)

ASTM D 2000	(2001) Rubber Products in Automotive Applications
ASTM F 436	(2002) Hardened Steel Washers
ASTM F 436M	(1993; R 2000) Hardened Steel Washers (Metric)
ASTM F 442/F 442M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015	(1999) Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
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## AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C203	(2002; A C203a-99) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1999) Disinfecting Water Mains
AWWA C652	(1992) Disinfection of Water Storage Facilities
AWWA EWW	(1998) Standard Methods for the Examination of Water and Wastewater

## ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged
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## Fittings

ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2002) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.1	(1996) Square and Hex Bolts and Screws, Inch Series
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts (Inch Series)

## FM GLOBAL (FM)

FM P7825a	(2003) Approval Guide Fire Protection
FM P7825b	(2003) Approval Guide Electrical Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Life Safety Code
NFPA 13	(1999) Installation of Sprinkler Systems
NFPA 13D	(1999) Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes Sprinkler Systems
NFPA 13R	(1999) Installation of Sprinkler Systems in Residential Occupancies Up to and

Including Four Stories in Height

NFPA 1963	(1998) Fire Hose Connections
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES  
(NICET)

NICET 1014-7	(1995) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout
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UNDERWRITERS LABORATORIES (UL)

UL 668	(1995; Rev thru Dec 1998) Hose Valves for Fire Protection Service
UL Bld Mat Dir	(1999) Building Materials Directory
UL Fire Prot Dir	(2001) Fire Protection Equipment Directory

1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in all areas of the building. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Rack sprinklers shall be in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. The Contractor shall design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density of 0.1 gpm per square foot over the hydraulically most demanding 3,000 square feet of floor area. The minimum pipe size for branch lines in gridded systems shall be 1-1/4 inch. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed 20 ft/s.

1.2.1.1 Hose Demand

An allowance for exterior hose streams of 250 gpm shall be added to the sprinkler system demand at the point of connection to the existing system.

#### 1.2.1.2 Basis for Calculations

Hydraulic calculations shall be based on operation of the fire pump(s) provided in Section 13920A FIRE PUMPS and following hydraulic data at point of connection to site water main--static pressure; 40 psig; flow: 750gpm; residual pressure: 20 psig.

#### 1.2.2 Sprinkler Coverage

Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13, but shall not exceed 100 square feet for extra hazard occupancies, 130 square feet for ordinary hazard occupancies, and 225 square feet for light hazard occupancies. Exceptions are as follows:

1) Facilities that are designed in accordance with NFPA 13R and NFPA 13D.

2) Sprinklers may be omitted from small rooms which are exempted for specific occupancies in accordance with NFPA 101.

#### 1.3 COORDINATION OF TRADES

Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction. Sprinkler shall be installed over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage.

#### 1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

#### 1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

#### 1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G.

Three copies of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of sprinkler system installation.

As-Built Drawings; G.

As-built shop drawings, at least 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

SD-03 Product Data

Fire Protection Related Submittals; .

A list of the Fire Protection Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist.

Sway Bracing; G.

For systems that are required to be protected against damage from earthquakes, load calculations shall be provided for sizing of sway bracing.

Materials and Equipment; G.

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations; G.

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

Spare Parts; G.

Spare parts data shall be included for each different item of material and equipment specified.

Preliminary Tests; G.

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests. Proposed date and time to begin the preliminary tests.

Final Acceptance Test; G.

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests. Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

On-site Training; G.

Proposed On-site Training schedule, at least 14 days prior to the start of related training.

Fire Protection Specialist; G; .

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer; G.

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

#### SD-06 Test Reports

Preliminary Test Report; G.

Three copies of the completed Preliminary Test Report, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

Final Acceptance Test Report; G.

Three copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

#### SD-07 Certificates

Inspection by Fire Protection Specialist; G.

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test



## Reports.

## SD-10 Operation and Maintenance Data

## Operating and Maintenance Instructions; .

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

## 1.7 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the drawings. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

## 1.8 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level IV Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly

engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

#### 1.9 SPRINKLER SYSTEM INSTALLER

Work specified in this section shall be performed by the Sprinkler System Installer. The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

#### 1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

#### 1.11 SPARE PARTS

The Contractor shall submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

#### 1.12 SHOP DRAWINGS

The Sprinkler System Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

- a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

- b. Floor plans drawn to a scale not less than  $1/8" = 1'-0"$  which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### 2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

### 2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b

### 2.4 UNDERGROUND PIPING COMPONENTS

#### 2.4.1 Pipe

Piping from a point 6 inches above the floor to the point of connection to the existing water mains shall be ductile iron with a rated working pressure of 175 psi conforming to AWWA C151, with cement mortar lining conforming to AWWA C104. Piping more than 5 feet outside the building walls shall comply with Section 02510A WATER DISTRIBUTION SYSTEM.

#### 2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111.

### 2.4.3 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 3 feet above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

## 2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel.

### 2.5.1 Steel Piping Components

#### 2.5.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53/A 53M, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

#### 2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Steel press fittings shall be approved for fire protection systems. Galvanized fittings shall be used for piping systems or portions of piping systems utilizing galvanized piping. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

#### 2.5.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 175 psi service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

#### 2.5.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1/16 inch thick, and full face or self-centering flat ring type.

#### 2.5.1.5 Bolts, Nut, and Washers

Bolts shall be squarehead conforming to ASME B18.2.1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque. Nuts shall be hexagon type conforming to ASME B18.2.2. Washers shall meet the requirements of ASTM F 436. Flat circular washers shall be provided under all bolt heads and nuts.

#### 2.5.2 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and sized to be supported.

#### 2.5.3 Valves

##### 2.5.3.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b.

##### 2.5.3.2 Check Valve

Check valve 2 inches and larger shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b. Check valves 4 inches and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

#### 2.6 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

#### 2.7 WATERFLOW ALARM

Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow alarm bell shall be rated 24 VDC and shall be connected to the Fire Alarm Control Panel(FACP) in accordance with Section 13851A FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.

#### 2.8 ALARM INITIATING AND SUPERVISORY DEVICES

##### 2.8.1 Sprinkler Waterflow Indicator Switch, Vane Type

Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 10 gpm or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility

of false alarms caused by transient flow surges. Initial setting shall be 30 seconds. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

#### 2.8.2 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

#### 2.9 FIRE DEPARTMENT CONNECTION

Fire department connection shall be flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a chromium plated finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 2-1/2 inch diameter American National Fire Hose Connection Screw Threads (NH) per the Base Fire Department.

#### 2.10 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classification shall be ordinary. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used.

##### 2.10.1 Concealed Sprinkler

Concealed sprinkler shall be chrome-plated, quick-response type and shall have a nominal 1/2 inch or 17/32 inch orifice.

##### 2.10.2 Recessed Sprinkler

Upright sprinkler shall be chrome-plated quick-response type and shall have a nominal 1/2 inch or 17/32 inch orifice.

##### 2.10.3 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, quick-response type with nominal 1/2 inch or 17/32 inch orifice. Pendent sprinklers shall have a polished chrome finish.

##### 2.10.4 Upright Sprinkler

Upright sprinkler shall be brass quick-response type and shall have a nominal 1/2 inch or 17/32 inch orifice.

2.10.5 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 1/2 inch orifice. Sidewall sprinkler shall have a polished chrome finish. Sidewall sprinkler shall be the quick-response type.

2.10.6 Corrosion Resistant Sprinkler

Corrosion resistant sprinkler shall be the upright type installed in the Mechanical Room. Corrosion resistant coatings shall be factory-applied by the sprinkler manufacturer.

2.11 DISINFECTING MATERIALS

2.11.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.11.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.12 ACCESSORIES

2.12.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.12.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 3/4 inch and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.12.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

2.12.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located in the Mechanical & Electrical Rooms.

2.12.5 Identification Sign

Valve identification sign shall be minimum 6 inches wide x 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.024 inch aluminum

with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

#### 2.13 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 175 psi. The maximum pressure loss shall be 6 psi at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be provided both upstream and downstream of the double check backflow prevention assembly valves.

### PART 3 EXECUTION

#### 3.1 FIRE PROTECTION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

#### 3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 13.

#### 3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

#### 3.4 ABOVEGROUND PIPING INSTALLATION

##### 3.4.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection shall include flexible and rigid couplings, sway bracing, seismic separation assemblies where piping crosses building seismic



separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes.

#### 3.4.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

#### 3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

#### 3.4.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 1 inch pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 12 inches. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 1 inch below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 4 inches. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

##### 3.4.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 6 inches from ceiling grid.

#### 3.4.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 30 inches in length shall be individually supported.

#### 3.4.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site.

Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools

shall be products of the same manufacturer. For copper tubing, pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

#### 3.4.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 1/2 inch.

#### 3.4.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07840A FIRESTOPPING.

In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

#### 3.4.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

#### 3.4.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 1 inch pipe connected at the riser as a combination test and drain valve; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the

building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

#### 3.4.11 Drains

Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as required by NFPA 13.

#### 3.4.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 3 feet above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

#### 3.4.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

### 3.5 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 3 feet. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 6 inches above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls shall meet the requirements of Division 2.

### 3.6 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Division 2.

### 3.7 ELECTRICAL WORK

Except as modified herein, electric equipment and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13851A FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE. All wiring for supervisory and alarm circuits shall be #14 AWG solid copper installed in metallic tubing or conduit. Wiring color code shall remain uniform throughout the system.

### 3.8 DISINFECTION

After all system components are installed and hydrostatic test(s) are successfully completed, each portion of the sprinkler system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. Flushing shall be conducted by removing the flushing fitting of the cross mains and of the grid branch lines, and then back-flushing through the sprinkler main drains. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained. After successful completion, verify installation of all sprinklers and plugs and pressure test the system.

### 3.9 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTS AND COATINGS.

### 3.10 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

#### 3.10.1 Underground Piping

##### 3.10.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This

includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less than the calculated maximum water demand rate of the system.

#### 3.10.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints, regardless of pipe diameter.

#### 3.10.2 Aboveground Piping

##### 3.10.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 200 psi or 50 psi in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

##### 3.10.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor shall provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5 inch diameter hoses, playpipe nozzles, calibrated pressure gauges, and pitot tube gauge. The Contractor shall provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. A metal placard shall be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate. The pressure drop shall be compared to the manufacturer's data.

#### 3.10.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm device shall be tested to verify proper operation.

#### 3.10.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

## 3.11 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. The Contractor shall submit the Final Acceptance Test Report as specified in the Submittals paragraph.

## 3.12 ON-SITE TRAINING

The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 8 hours of normal working time and shall start after the system is functionally complete but prior to the Preliminary Tests and Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS  
09/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117 (1997) Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (1997) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1998; Errata 1999) Motors and Generators

NEMA MG 10 (1994) Energy Management Guide for  
Selection and Use of Fixed Frequency  
Medium AC Squirrel-Cage Polyphase  
Induction Motors

NEMA MG 11 (1977; R 1992) Energy Management Guide of  
Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 15, "Mechanical" of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and

materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

#### 1.3.2 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

#### 1.3.3 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

#### 1.3.4 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.3.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

##### 1.3.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

##### 1.3.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied



appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

#### 1.5 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 16402N, "Interior Distribution System." Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 16402N, "Interior Distribution System."

#### 1.6 ELECTRICAL INSTALLATION REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

##### 1.6.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 16, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

##### 1.6.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 16.

### 1.6.3 High Efficiency Motors

#### 1.6.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

#### 1.6.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

#### 1.6.4 Three-Phase Motor Protection

Provide controllers for motors rated one one horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

### 1.7 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

### 1.8 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

## 3.1 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

## 3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

## 3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

- a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.
- b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

- c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

## SECTION 15070A

SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT  
01/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION  
(SMACNA)

SMACNA Seismic Restraint Mnl (1998) Seismic Restraint Manual Guidelines  
for Mechanical Systems

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04 (1998) Seismic Design for Buildings

## 1.2 SYSTEM DESCRIPTION

## 1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems listed below. Structural requirements shall be in accordance with Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

## 1.2.2 Mechanical Equipment

Mechanical equipment to be seismically protected shall include the following items to the extent required on the drawings or in other sections of these specifications:

Boilers and furnaces	Storage Tanks for Oil and Water
Water Heaters	Steam, Water, Oil and Gas Piping
Expansion Air Separator Tanks	Valves and Fittings for Piping
Heat Exchangers	Steam-fed Kitchen Appliances
Water Chiller Units	Thermal Storage Units
Cooling Towers	Air and Refrigerant Compressors
Refrigerant Piping	Air Handling Units
Pumps with Motors	Lab Scrubbers
Large Commercial Dryers	Pollution Control Equipment
Gas Dryers	Ducts
Flash Tanks	Unit Heaters
Accumulator Tank	Exhaust and Return Fans

### 1.2.3 Mechanical Systems

The following mechanical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

- All Piping Inside the Building Except as Specifically Stated Below Under "Items Not Covered By This Section".
- Chilled Water Distribution Systems Outside of Buildings
- Fuel Piping Outside of Buildings
- All Water Supply Systems
- Storm and Sanitary Sewer Systems
- All Process Piping
- Heat Distribution Systems (Supply, Return, and Condensate Return) Outside of Buildings
- Condenser Water Piping Outside the Building
- Pneumatic Tube Distribution System
- Cold Storage Refrigeration Systems
- Fuel Storage Tanks
- Water Storage Tanks

### 1.2.4 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with TI 809-04 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. TI 809-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using TI 809-04 are based on strength design; therefore, AISC 325 Specifications shall be used for the design. The bracing for the following mechanical equipment and systems shall be developed by the Contractor.

### 1.2.5 Items Not Covered By This Section

#### 1.2.5.1 Fire Protection Systems

Seismic protection of piping for fire protection systems shall be installed as specified in Sections 13920A FIRE PUMPS, 13930A WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION, 13935A DRY PIPE SPRINKLER SYSTEM, FIRE PROTECTION, 13945A PREACTION AND DELUGE SPRINKLER SYSTEMS, FIRE PROTECTION, and 13955A AQUEOUS FILM-FORMING FOAM (AFFF) FIRE PROTECTION SYSTEM.

#### 1.2.5.2 Items Requiring No Seismic Restraints

Seismic restraints are not required for the following items:

- a. Gas piping less than 1inch inside diameter.
- b. Piping in boiler and mechanical equipment rooms less than 1-1/4 inches inside diameter.
- c. All other piping less than 2-1/2inches inside diameter.

- d. Rectangular air handling ducts less than 6 square feet in cross sectional area.
- e. Round air handling ducts less than 28 inches in diameter.
- f. Piping suspended by individual hangers 12 inches or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.
- g. Ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the supporting structural member, except as noted below.

In exemptions f. and g. all hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the entire run shall be braced. Interior piping and ducts not listed above shall be seismically protected in accordance with the provisions of this specification.

### 1.3 EQUIPMENT REQUIREMENTS

#### 1.3.1 Rigidly Mounted Equipment

The following specific items of equipment that are to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in TI 809-04, Chapter 10. Each item of rigid equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, duct, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

- Boilers
- Chillers
- Air-Handling Units
- Cooling Towers
- Surge Tanks

#### 1.3.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of \_\_\_\_\_ times the operating weight of the equipment at the vertical center of gravity of the equipment.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Coupling and Bracing; .  
Flexible Couplings or Joints; .  
Equipment Requirements; .  
Contractor Designed Bracing; G.

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

#### SD-03 Product Data

Coupling and Bracing; G.  
Equipment Requirements; G.

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G.

Copies of the design calculations with the drawings. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

#### SD-07 Certificates

Flexible Ball Joints; .

Flexible ball joints shall be certified to be suitable for the service intended by the manufacturer. Information verifying experience at not less than 3 locations of 2 years' satisfactory operation in a similar application shall be submitted.

### PART 2 PRODUCTS

#### 2.1 FLEXIBLE COUPLINGS

Flexible couplings shall have same pressure and temperature ratings as adjoining pipe.

#### 2.2 FLEXIBLE BALL JOINTS

Flexible ball joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation with not less than 15-degree angular movement.



## 2.3 FLEXIBLE MECHANICAL JOINTS

- a. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.
- b. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets.

## 2.4 MANUFACTURED BALL JOINTS

Manufactured ball joints shall be as recommended by the manufacturer for the intended use, and shall be approved by the Contracting Officer before installation.

## 2.5 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

# PART 3 EXECUTION

## 3.1 COUPLING AND BRACING

Coupling installation shall conform to the details shown on the drawings. Provisions of this paragraph apply to all piping within a 5 foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the most frequent interval as determined by applying the requirements of this specification to each piping run on the common support. Bracing components shall be sized as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

## 3.2 BUILDING DRIFT

Joints capable of accommodating seismic displacements shall be provided for vertical piping between floors of the building, where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. Horizontal piping across expansion joints shall accommodate the resultant of the drifts of each building unit in each orthogonal direction. For threaded piping, swing joints made of the same piping material shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 feet per foot of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's

selection table.

### 3.3 FLEXIBLE COUPLINGS OR JOINTS

#### 3.3.1 Building Piping

Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers for pipe larger than 3-1/2 inches in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to satisfy these requirements.

#### 3.3.2 Underground Piping

Underground piping and 4 inch or larger conduit, except heat distribution system, shall have flexible couplings installed where the piping enters the building. The couplings shall accommodate 2 inches of relative movement between the pipe and the building in any direction. Additional flexible couplings shall be provided where shown on the drawings.

### 3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve. Pipe sleeves in fire rated walls shall conform to the requirements in Section 07840A FIRESTOPPING.

### 3.5 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 3.6 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

### 3.6.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided as specified in Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT. All runs (length of pipe between end joints) shall have a minimum of two transverse braces. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400A PLUMBING, GENERAL PURPOSE.

### 3.6.2 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at 40 foot intervals unless otherwise indicated. All runs (length of pipe between end joints) shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

### 3.6.3 Vertical Runs

Run is defined as length of pipe between end joints. Vertical runs of piping shall be braced at not more than 10 foot vertical intervals. Braces for vertical runs shall be above the center of gravity of the segment being braced. All sway braces shall be constructed in accordance with the drawings. Sway branches shall not be connected to branch lines, walls, or floors.

### 3.6.4 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation in accordance with Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

## 3.7 SWAY BRACES FOR DUCTS

### 3.7.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with SMACNA Seismic Restraint Mnl, including Appendix E. However, the design seismic loadings for these items shall not be less than loadings obtained using the procedures in TI 809-04.

### 3.7.2 Unbraced Ducts

Hangers for unbraced ducts shall be attached to the duct within 2 inches of the top of the duct in accordance with SMACNA Seismic Restraint Mnl. Unbraced ducts shall be installed with a 6 inch minimum clearance to vertical ceiling hanger wires.

-- End of Section --

## SECTION 15080A

THERMAL INSULATION FOR MECHANICAL SYSTEMS  
07/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM B 209	(2001) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2001) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 1126	(2000) Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C 1136	(1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1290	(2000e1) Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 449/C 449M	(2000) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1995; R 2001) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(2001a) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

ASTM C 547	(2000) Mineral Fiber Pipe Insulation
ASTM C 552	(2000) Cellular Glass Thermal Insulation
ASTM C 553	(2000) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 591	(2001) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 610	(1999) Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C 612	(2000a) Mineral Fiber Block and Board Thermal Insulation
ASTM C 647	(1995; R 2000) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 665	(2001e1) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 795	(1992; R 1998e1) Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C 916	(1985; R 1996e1) Adhesives for Duct Thermal Insulation
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM C 921	(1989; R 1996) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D 882	(1997) Tensile Properties of Thin Plastic Sheeting
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
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## MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds (1999) National Commercial & Industrial  
Insulation Standards

## 1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Insulation of heat distribution systems and chilled water systems outside of buildings shall be as specified in Section 02552A PRE-ENGINEERED UNDERGROUND HEAT DISTRIBUTION SYSTEM, Section 02553A HEAT DISTRIBUTION SYSTEMS IN CONCRETE TRENCHES, Section 02554A ABOVEGROUND HEAT DISTRIBUTION SYSTEM, and Section 02555A PREFABRICATED UNDERGROUND HEATING/COOLING DISTRIBUTION SYSTEM. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

## 1.3 GENERAL QUALITY CONTROL

## 1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

## 1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

## 1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread, and smoke developed indexes, shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

## 1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name

of the manufacturer and brand, and a description of the material.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

###### Mica Plates; .

After approval of materials and prior to applying insulation, a booklet shall be prepared and submitted for approval. The booklet shall contain marked-up MICA Insulation Stds plates (or detail drawings showing the insulation material and insulating system) for each pipe, duct, or piece of equipment that must be insulated per this specification. The MICA plates shall be marked up showing the materials to be installed in accordance with the requirements of this specification for the specific insulation application. The Contractor shall submit all MICA Plates required to show the entire insulating system, including Plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. If the Contractor elects to submit detailed drawings instead of marked-up MICA Plates, the detail drawings shall show cut-away, section views, and details indicating each component of the insulation system and showing provisions for insulating jacketing, and sealing portions of the equipment. For each type of insulation installation on the drawings, provide a label that identifies each component in the installation (i.e., the duct, insulation, adhesive, vapor retarder, jacketing, tape, mechanical fasteners, etc.) Indicate insulation by type and manufacturer. Three copies of the booklet shall be submitted at the jobsite to the Contracting Officer. One copy of the approved booklet shall remain with the insulation Contractor's display sample and two copies shall be provided for Government use.

##### SD-03 Product Data

###### General Materials; .

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

##### SD-04 Samples

## Thermal Insulation Materials; G.

After approval of materials actual sections of installed systems, properly insulated in accordance with the specification requirements, shall be displayed. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

Duct Insulation Display Sections: Display sample sections for rigid and flexible duct insulation used on the job. A temporary covering shall be used to enclose and protect display sections for duct insulation exposed to weather.

## 1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means.

## PART 2 PRODUCTS

## 2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:



## 2.1.1 Adhesives

## 2.1.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I.

## 2.1.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

## 2.1.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a flame spread rating no higher than 25 and a smoke developed rating no higher than 50 when tested in accordance with ASTM E 84. Adhesive shall be pigmented white \_\_\_\_ or red and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding fibrous glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

## 2.1.2 Contact Adhesive

Adhesives may be dispersed in a volatile organic solvent. Adhesives may be any of, but not limited to, the neoprane based, rubber based, or elastomeric type that have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in the dry state in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

## 2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

#### 2.1.4 Corner Angles

Nominal 0.016 inch aluminum 1 x 1 inch with factory applied kraft backing. Aluminum shall be ASTM B 209, Alloy 3003, 3105, or 5005.

#### 2.1.5 Finishing Cement

ASTM C 449/C 449M: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must include testing per ASTM C 795.

#### 2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Tape shall be 4 inch wide rolls.

#### 2.1.7 Staples

Outward clinching type ASTM A 167, Type 304 or 316 stainless steel. Monel is a nickel rich alloy that has high strength, high ductility, and excellent resistance to corrosion.

#### 2.1.8 Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, (measured before factory application or installation), minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require factory applied jackets are mineral fiber, cellular glass, and phenolic foam. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

##### 2.1.8.1 White Vapor Retarder All Service Jacket (ASJ)

For use on hot/cold pipes, ducts, or equipment vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

##### 2.1.8.2 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture retarder. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 x 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 x

0.020 inch) thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

#### 2.1.8.3 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

#### 2.1.9 Vapor Retarder Required

##### 2.1.9.1 Vapor Retarder Mastic Coatings

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

##### 2.1.9.2 Laminated Film Vapor Retarder

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable.

##### 2.1.9.3 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested per ASTM D 882, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

##### 2.1.9.4 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for PVDC Film Vapor Retarder in paragraph 2.1.9.2 above.

#### 2.1.10 Vapor Retarder Not Required

ASTM C 1136, Type III, maximum moisture vapor transmission 0.10 perms, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable.

#### 2.1.11 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

## 2.1.12 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread/smoke developed index of 25/50 per ASTM E 84.

## 2.2 PIPE INSULATION MATERIALS

The Contractor shall comply with EPA requirements in accordance with Section 01670A RECYCLED / RECOVERED MATERIALS. Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

## 2.2.1 Aboveground Cold Pipeline

Insulation for minus 30 degrees to plus 60 degrees F for outdoor, indoor, exposed or concealed applications, shall be as follows:

- a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.
- b. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II. Type II shall have vapor retarder skin on both sides of the insulation.
- c. Phenolic Insulation: ASTM C 1126, Type III. Phenolic insulations shall comply with ASTM C 795 and with the ASTM C 665 paragraph Corrosiveness. Supply the insulation with manufacturer's recommended factory-applied jacket.
- d. Polyisocyanurate Insulation: ASTM C 591, type I. Supply the insulation with manufacturer's recommended factory-applied vapor retarder.

## 2.2.2 Aboveground Hot Pipeline

Insulation for above 60 degrees F, for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket.

- a. Mineral Fiber: ASTM C 547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.
- b. Calcium Silicate: ASTM C 533, Type I indoor only, or outdoors above 250 degrees F pipe temperature. Supply insulation with the manufacturer's recommended factory-applied jacket.
- c. Cellular Glass: ASTM C 552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.
- d. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II to 200 degrees F service.

- e. Phenolic Insulation: ASTM C 1126 Type III to 250 F service shall comply with ASTM C 795. Supply the insulation with manufacturer's recommended factory-applied jacket.
- f. Perlite Insulation: ASTM C 610
- g. Polyisocyanurate Insulation: ASTM C 591, Type 1, to 300 degrees F service. Supply the insulation with manufacturer's recommended factory applied jacket.

#### 2.2.3 Above Ground Dual Temperature Pipeline - Outdoors, Indoor - Exposed or Concealed

Selection of insulation for use over a dual temperature pipeline system shall be in accordance with the most limiting/restrictive case. Find an allowable material from paragraph PIPE INSULATION MATERIALS and determine the required thickness from the most restrictive case. Use the thickness listed in paragraphs INSULATION THICKNESS for cold & hot pipe applications.

#### 2.2.4 Below-ground Pipeline Insulation

For below-ground pipeline insulation the following requirements shall be met.

##### 2.2.4.1 Cellular Glass

ASTM C 552, type II.

##### 2.2.4.2 Polyisocyanurate

ASTM C 591, Type 1, to 300 degrees F.

#### 2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be limited to those listed herein and shall meet the following requirements:

##### 2.3.1 Rigid Mineral Fiber

ASTM C 612: Type IA, IB, II, III, & IV.

##### 2.3.2 Flexible Mineral Fiber

ASTM C 553: Type I, or Type II up to 250 F. ASTM C 1290 Type III.

##### 2.3.3 Cellular Glass

ASTM C 552, Type I.

##### 2.3.4 Phenolic Foam

ASTM C 1126: Type II shall comply with ASTM C 795.

#### 2.3.5 Flexible Elastomeric Cellular

ASTM C 534: Type II.

#### 2.3.6 Polyisocyanurate

ASTM C 591: Type 1. Supply the insulation with manufacturer's recommended factory-applied jacket.

### 2.4 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be limited to those listed herein and shall meet the following requirements:

#### 2.4.1 Cold Equipment Insulation

For equipment operating temperatures below 60 degrees F.

##### 2.4.1.1 Cellular Glass

ASTM C 552: Type I, Type III, or Type IV as required.

##### 2.4.1.2 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II.

##### 2.4.1.3 Phenolic Foam

ASTM C 1126: Type II shall comply with ASTM C 795.

##### 2.4.1.4 Polyisocyanurate Foam

ASTM C 591, Type I. Supply the insulation with manufacturer's factory-applied jacket.

#### 2.4.2 Hot Equipment Insulation

For equipment operating temperatures above 60 degrees F.

##### 2.4.2.1 Rigid Mineral Fiber

ASTM C 612: Type IA, IB, II, III, IV, or V as required for temperatures encountered to 1800 degrees F.

##### 2.4.2.2 Flexible Mineral Fiber

ASTM C 553: Type I, II, III, IV, V, VI or VII as required for temperatures encountered to 1200 degrees F.

##### 2.4.2.3 Calcium Silicate

ASTM C 533, Type I, in-doors only, or outdoors above 250 degrees F. Pipe shape may be used on diesel engine exhaust piping and mufflers to 1200 degrees F.

#### 2.4.2.4 Cellular Glass

ASTM C 552: Type I, Type III, or Type IV as required.

#### 2.4.2.5 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II, to 200 degrees F.

#### 2.4.2.6 Phenolic Foam

ASTM C 1126, Type II, to 250 degrees F shall comply with ASTM C 795.

#### 2.4.2.7 Molded Expanded Perlite

ASTM C 610.

#### 2.4.2.8 Polyisocyanurate Foam:

ASTM C 591, Type I to 300 degrees F service. Supply the insulation with manufacturer's recommended factory-applied jacket.

### PART 3 EXECUTION

#### 3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

##### 3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

##### 3.1.2 Fire-stopping

Where pipes and ducts pass through fire walls, fire partitions, above grade

floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07840A FIRESTOPPING.

### 3.1.3 Painting and Finishing

Painting shall be as specified in Section 09900 PAINTS AND COATINGS.

### 3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Flexible elastomeric cellular insulation shall be installed with seams and joints sealed with rubberized contact adhesive. Insulation with pre-applied adhesive is not permitted. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 200 degrees F. Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry. A brush coating of adhesive shall be applied to both butt ends to be joined and to both slit surfaces to be sealed. The adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

### 3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

### 3.1.6 Pipes/Ducts/Equipment which Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items, as specified.

## 3.2 PIPE INSULATION INSTALLATION

### 3.2.1 Pipe Insulation

#### 3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.



- c. Sanitary drain lines.
- d. Air chambers.

#### 3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

- a. Pipe insulation shall be continuous through the sleeve.
- b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.
- c. Where pipes penetrate interior walls, the aluminum jacket shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.
- d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.
- e. Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.
- f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.
- g. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 2 inches down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.
- h. For hot water pipes supplying lavatories or other similar heated service that requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Glass tape seams shall overlap 1 inch. The annular space between the pipe and wall penetration shall be caulked with approved fire stop material. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.
- i. For domestic cold water pipes supplying lavatories or other similar cooling service that requires insulation, the insulation shall be terminated on the finished side of the wall (i.e.,

insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch. The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and the wall penetration shall be caulked with an approved fire stop material having vapor retarder properties. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

#### 3.2.1.3 Pipes Passing Through Hangers

- a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed.
- b. Horizontal pipes larger than 2 inches at 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69, and Section 15400A PLUMBING, GENERAL PURPOSE.
- c. Horizontal pipes larger than 2 inches and below 60 degrees F shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass, calcium silicate (or perlite above 80 F), or the necessary strength polyisocyanurate shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.
- d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing

insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

- e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 1-1/2 inches, and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C 1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

#### 3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

#### 3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected. Other areas that specifically require protection to the 6 foot level are inside custom air handling units.

#### 3.2.2 Aboveground Cold Pipelines

The following cold pipelines shall be insulated per Table I minus 30 degrees to plus 60 degrees F:

- a. Domestic cold and chilled drinking water.
- b. Make-up water.
- c. Horizontal and vertical portions of interior roof drains.
- d. Refrigerant suction lines.
- e. Chilled water.
- f. Air conditioner condensate drains.

- g. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

### 3.2.2.1 Insulation Thickness

Insulation thickness for cold pipelines shall be determined using Table I.

Table I - Cold Piping Insulation Thickness  
Pipe Size (inches)

Type of Service	Material	Run-outs up to 2 in*	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
Refrigerant suction piping	CG		1.5	1.5	1.5	1.5	1.5
	FC		1.0	1.0	1.0	1.0	1.0
	PF		1.5	1.5	1.5	1.5	1.5
	PC		1.0	1.0	1.0	1.0	1.0
Chilled water supply & return & dual temp piping	CG	1.5	1.5	1.5	2.0	2.0	2.0
	FC	0.5	1.0	1.0	1.0	1.0	1.0
	PF	1.5	1.5	1.5	1.5	1.5	1.5
	PC	1.0	1.0	1.0	1.0	1.0	1.0
Cold domestic water, above and below ceilings & makeup water	CG	1.5	1.5	1.5	1.5	1.5	1.5
	FC	3/8	3/8	3/8	3/8	3/8	3/8
	PF	1.5	1.5	1.5	1.5	1.5	1.5
	PC	1.0	1.0	1.0	1.0	1.0	1.0
Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap personnel	FC	0.5	0.5	0.5	0.5	3/4	3/4
	MF	0.5	1.0	1.0	1.5	1.5	1.5
Horizontal & vertical roof drain leaders (including underside of roof drain fitting)	FC		0.5	0.5	0.5	0.5	0.5
	PF		1.5	1.5	1.5	1.5	1.5
	CG		1.5	1.5	1.5	1.5	1.5
	PC		1.0	1.0	1.0	1.0	1.0
Air conditioning condensate	FC		3/8	0.5	0.5	N/A	N/A
	PF		1.5	1.5	1.5	N/A	N/A
	PC		1.0	1.0	1.0	N/A	N/A

Table I - Cold Piping Insulation Thickness  
Pipe Size (inches)

Type of Service	Material	Run-outs up to 2 in*	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
drain located inside building							

\*When run-outs to terminal units exceed 12 feet, the entire length of run-out shall be insulated like main feed pipe. Insulations may not be applied if their flame and smoke developed ratings exceed the requirements of 25/50 established in this guide specification. Layered insulations, or installation where multiple layers of the same insulation are used, must be checked for this (in particular if the insulation has been rated per ASTM E 84 for one thickness).

## LEGEND:

PF - Phenolic Foam  
CG - Cellular Glass  
MF - Mineral Fiber  
FC - Flexible Elastomeric Cellular  
PC - Polyisocyanurate Foam

### 3.2.2.2 Jacket for Mineral Fiber, Cellular Glass, Phenolic Foam, and Polyisocyanurate Foam Insulated Pipe

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket. Insulation inside the building, to be protected with an aluminum jacket, shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 6 ft level shall be protected. Other areas that specifically require protection to the 6 ft level are in custom air handling units.

### 3.2.2.3 Insulation for Straight Runs (Mineral Fiber, Cellular Glass, Phenolic Foam and Polyisocyanurate Foam)

- a. Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape.
- b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches. Butt strips 3 inches wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. If staples are used,

they shall be sealed per item "e." below. Note that staples are not required with cellular glass systems.

- d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- e. All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating or PVDC adhesive tape. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating or PVDC adhesive tape.
- f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating or PVDC adhesive tape. The patch shall extend not less than 1-1/2 inches past the break.
- g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating or PVDC adhesive tape.

#### 3.2.2.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape.
- b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".
- c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape

embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

- d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.
- e. Insulation shall be marked showing the location of unions, strainers, and check valves.

#### 3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

#### 3.2.3 Aboveground Hot Pipelines

The following hot pipelines above 60 degrees F shall be insulated per Table II:

- a. Domestic hot water supply & re-circulating system.
- b. Steam.
- c. Condensate & compressed air discharge.
- d. Hot water heating.
- e. Heated oil.
- f. Water defrost lines in refrigerated rooms.

##### 3.2.3.1 Insulation Thickness

Insulation thickness for hot pipelines shall be determined using Table II.

##### LEGEND:

PF - Phenolic Foam

CG - Cellular Glass  
 CS - Calcium Silicate  
 MF - Mineral Fiber  
 FC - Flexible Elastomeric Cellular  
 PL - Perlite  
 PC - Polyisocyanurate Foam

Table II - Hot Piping Insulation Thickness  
 Pipe Size (inches)

Type of Service (degrees F)	Material	Run-outs up to 2 in *	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
Hot domestic water supply & re-circulating system, & water defrost lines (200 F max)**	CG	1.5	1.5	1.5	1.5	1.5	1.5
	FC	0.5	0.5	1.0	1.0	1.5	1.5
	PF	0.5	0.5	1.0	1.0	1.0	1.0
	MF	0.5	1.5	1.5	1.5	1.5	1.5
	PC	1.0	1.0	1.0	1.0	1.0	1.0
Compressed Air discharge steam & condensate return (201-250 F)	CG		1.5	2.0	2.0	2.0	3.5
	PF		1.0	1.0	1.0	1.0	1.5
	MF		1.5	1.5	2.0	2.0	2.5
	CS/PL		1.5	2.0	2.5	2.5	3.5
	PC		1.0	1.0	1.0	1.0	1.0
Heating hot water, supply & return, & Heating oil (250 F max)	CG	1.5	1.5	2.0	2.0	2.5	3.0
	PF	0.5	1.0	1.0	1.0	1.0	1.5
	MF	0.5	1.5	1.5	2.0	2.5	3.0
	CS	1.0	1.5	2.0	2.5	2.5	3.0
	PC	1.0	1.0	1.0	1.0	1.0	1.0

\* When run-outs to terminal units exceed 12 feet, the entire length of run-out shall be insulated like the main feed pipe.

\*\* Applies to re-circulating sections of service or domestic hot water systems and first 8 feet from storage tank for non-re-circulating systems.

### 3.2.3.2 Jacket for Insulated Hot Pipe, Except Pipe Insulated with Flexible Elastomeric Cellular

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type II jacket or field applied aluminum where required or seal welded PVC.

### 3.2.3.3 Insulation for Straight Runs

- a. Insulation shall be applied to the pipe with joints tightly butted.



- b. Longitudinal laps of the jacket material shall overlap not less than 1-1/2 inches, and butt strips 3 inches wide shall be provided for circumferential joints.
- c. Laps and butt strips shall be secured with adhesive and stapled on 4 inch centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.
- d. Factory self-sealing lap systems may be used when the ambient temperature is between 40 degrees and 120 degrees F and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is non-adhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- e. Breaks and punctures in the jacket material shall be patched by either wrapping a strip of jacket material around the pipe and securing with adhesive and staple on 4 inch centers (if not factory self-sealing), or patching with tape and sealing with a brush coat of vapor retarder coating. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 1-1/2 inches past the break.
- f. Installation of flexible elastomeric cellular pipe insulation shall be by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slitted sections over the open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used. Type II sheet insulation when used on pipe larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

#### 3.2.3.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories.
- b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates, except as modified herein: 5 for anchors; 10, 11, 12, and 13 for fittings; 14, 15 and 16 for valves; 17 for flanges and unions; and 18 for couplings. Insulation shall be the same as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is

used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

- c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory jackets or PVC fitting covers shall be protected with two coats of adhesive applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. Adhesive shall extend onto the adjoining insulation not less than 2 inches. The total dry film thickness shall be not less than 1/16 inch.
- d. Insulation terminations shall be tapered to unions at a 45-degree angle.
- e. At the option of the Contractor, factory pre-molded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory pre-molded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers.

#### 3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, an aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION.

##### 3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

##### 3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape

embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof.

#### 3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

### 3.3 DUCT INSULATION INSTALLATION

Duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

#### 3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table III. Maximum thickness for flexible elastomeric cellular insulation shall not exceed 25 mm, and maximum thickness for polyisocyanurate foam insulation shall not exceed 40 mm to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50

Table III - Minimum Duct Insulation (inches)

Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

Maximum thickness for flexible elastomeric cellular insulation shall not exceed 1 inch and maximum thickness for polyisocyanurate foam insulation shall not exceed 1.5 inch, to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50.

#### 3.3.2 Insulation and Vapor Retarder for Cold Air Duct

Insulation and vapor retarder shall be provided for the following cold air ducts and associated equipment.

- a. Supply ducts.

- b. Return air ducts.
- c. Relief ducts.
- d. Flexible run-outs (field-insulated).
- e. Plenums.
- f. Duct-mounted coil casings.
- g. Coil headers and return bends.
- h. Coil casings.
- i. Fresh air intake ducts.
- j. Filter boxes.
- k. Mixing boxes (field-insulated).
- l. Supply fans (field-insulated).
- m. Site-erected air conditioner casings.
- n. Ducts exposed to weather.
- o. Combustion air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf and rigid type where exposed, minimum density 3 pcf.

Insulation for round/oval ducts shall be flexible type, minimum density 3/4 pcf with a factory Type I or II jacket; or, a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered, with a factory applied Type I or II all service jacket. Insulation for exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a vapor retarder jacket coating finish as specified. Insulation on concealed duct shall be provided with a factory-applied Type I or II vapor retarder jacket. The total dry film thickness shall be approximately 1/16 inch.. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 15895A AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

#### 3.3.2.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6

inch wide strips on 12 inch centers.

- b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.
- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.
- d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.
- e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.
- f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape.
- g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape.
- h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape.
- i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches.  
Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

#### 3.3.2.2 Installation on Exposed Duct Work

- a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced

not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches.

- b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over.
- c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed or bent over.
- d. Joints in the insulation jacket shall be sealed with a 4 inchwide strip of tape. Tape seams shall be sealed with a brush coat of vapor retarder coating.
- e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.
- f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.
- g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.
- h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as per MICA standards.

### 3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

- a. Supply ducts.
- b. Return air ducts

- c. Relief air ducts
- d. Flexible run-outs (field insulated)
- e. Plenums
- f. Duct-mounted coil casings
- g. Coil-headers and return bends
- h. Coil casings.
- i. Fresh air intake ducts
- j. Filter boxes
- k. Mixing boxes
- l. Supply fans
- m. Site-erected air conditioner casings
- n. Ducts exposed to weather

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf; and rigid type where exposed, minimum density 3 pcf. Insulation on exposed ducts shall be provided with a white, paint-able, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, minimum density 3/4 pcf with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

#### 3.3.3.1 Installation on Concealed Duct

- a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.
- b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.
- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.
- d. The insulation shall be impaled on the mechanical fasteners where

used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.

- e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.
- f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

#### 3.3.3.2 Installation on Exposed Duct

- a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.
- b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.
- c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin excess clipped and bent over.
- d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.
- e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with adhesive and stapled.
- f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.
- g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

#### 3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts



shall be insulated as specified for cold air duct.

#### 3.3.5 Insulation for Evaporative Cooling Duct

Evaporative cooling supply duct located in spaces not evaporatively cooled, shall be insulated. Material and installation requirements shall be as specified for duct insulation for warm air duct.

#### 3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

#### 3.3.7 Duct Exposed to Weather

##### 3.3.7.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

##### 3.3.7.2 Round Duct

Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 3 inches and secured with bands located at circumferential laps and at not more than 12 inch intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with caulking to prevent moisture penetration. Where jacketing abuts an un-insulated surface, joints shall be sealed with caulking.

##### 3.3.7.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

##### 3.3.7.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws.

#### 3.4 EQUIPMENT INSULATION INSTALLATION

##### 3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted

on the following:

- a. Hand-holes.
- b. Boiler manholes.
- c. Cleanouts.
- d. ASME stamps.
- e. Manufacturer's nameplates.

#### 3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

- a. Pumps.
- b. Refrigeration equipment parts that are not factory insulated.
- c. Drip pans under chilled equipment.
- d. Cold water storage tanks.
- e. Water softeners.
- f. Duct mounted coils.
- g. Cold and chilled water pumps.
- h. Pneumatic water tanks.
- i. Roof drain bodies.
- j. Air handling equipment parts that are not factory insulated.
- k. Expansion and air separation tanks.

##### 3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

- a. Equipment handling media between 35 and 60 degrees F: 1.5 inch thick cellular glass, 1 inch thick flexible elastomeric cellular, 1.5 inch thick phenolic foam, or 1 inch thick polyisocyanurate foam.
- b. Equipment handling media between 0 degree F and 34 degrees F: 3 inch thick cellular glass, 1 1/2 inch flexible elastomeric cellular, 1 1/2 inch thick phenolic foam, or 1 1/2 inch thick polyisocyanurate foam.

- c. Equipment handling media between minus 30 degrees F and 1 degree F: 3 1/2 inch thick cellular glass 1 3/4 inch thick flexible elastomeric cellular, 1 1/2 inch thick phenolic foam, or 1 1/2 inch thick polyisocyanurate foam.

#### 3.4.2.2 Pump Insulation

- a. Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.
- b. Exposed insulation corners shall be protected with corner angles.
- c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Caulking shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

#### 3.4.2.3 Other Equipment

- a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.
- b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.
- c. Phenolic foam insulation shall be set in a coating of bedding compound and joints shall be sealed with bedding compound as recommended by the manufacturer. Cellular glass shall be installed in accordance with manufacturer's instructions. Joints and ends shall be sealed with joint sealant, and sealed with a vapor retarder coating.
- d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating

with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch.

- e. Exposed insulation corners shall be protected with corner angles.
- f. Insulation on equipment with ribs shall be applied over 6 x 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 x 2 inches washers or shall be securely banded or wired in place on 12 inch centers.

#### 3.4.2.4 Vapor Retarder

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

#### 3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

- a. Converters.
- b. Heat exchangers.
- c. Hot water generators.
- d. Water heaters.
- e. Pumps handling media above 130 degrees F.
- f. Air separation tanks.
- g. Flash tanks.

##### 3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table IV:

#### Legend

RMF: Rigid Mineral Fiber  
FMF: Flexible Mineral Fiber  
CS: Calcium Silicate  
PL: Perlite

CG: Cellular Glass  
 FC: Flexible Elastomeric Cellular  
 PF: Phenolic Foam  
 PC: Polyisocyanurate Foam

TABLE IV  
 Insulation Thickness for Hot Equipment (mm)

Equipment handling steam or other media to indicated pressure or temperature limit	Material	Thickness
103.4 kPa	RMF	50 mm
or	FMF	50 mm
121 C	CS/PL	100 mm
	CG	75 mm
	PF	40 mm
	FC(<93 C)	25 mm
	PC	25 mm
1379.0kPa	RMF	75 mm
or	FMF	75 mm
204 C	CS/PL	100 mm
	CG	100 mm
316 C	RMF	125 mm
	FMF	150 mm
	CS/PL	150 mm
	CG	150 mm

316 C: Thickness necessary to limit the external temperature of the insulation to 50 C, except that diesel engine exhaust piping and mufflers shall be covered with 150 mm thick material suitable for 650 degrees C service. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

TABLE IV  
 Insulation Thickness for Hot Equipment (Inches)

Equipment handling steam or media to indicated pressure or temperature limit:	Material	Thickness
15 psig	RMF	2.0 inches
or	FMF	2.0 inches
250F	CS/PL	4.0 inches
	CG	3.0 inches
	PF	1.5 inches

	FC (<200F)	1.0 inches
	PC	1.0 inches
200 psig	RMF	3.0 inches
or	FMF	3.0 inches
400 F	CS/PL	4.0 inches
	CG	4.0 inches
600 F	RMF	5.0 inches
	FMF	6.0 inches
	CS/PL	6.0 inches
	CG	6.0 inches

>600 F: Thickness necessary to limit the external temperature of the insulation to 120F, except that diesel engine exhaust piping and mufflers shall be covered with 6.0 inch thick material suitable for 1200 degrees F service. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

#### 3.4.3.2 Insulation of Pumps

Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing that does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations.

#### 3.4.3.3 Other Equipment

- a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.
- b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 12 inch centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.
- c. On high vibration equipment, cellular glass insulation shall be set in a coating of bedding compound as recommended by the manufacturer, and joints shall be sealed with bedding compound. Mineral fiber joints shall be filled with finishing cement.
- d. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female

shiplap type joint. Entire surface of the removable section shall be finished as specified.

- e. Exposed insulation corners shall be protected with corner angles.
- f. On equipment with ribs, such as boiler flue gas connection, draft fans, and fly ash or soot collectors, insulation shall be applied over 6 x 6 inch by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 x 2 inch washers or shall be securely banded or wired in place on 12 inch (maximum) centers.
- g. On equipment handling media above 600 degrees F, insulation shall be applied in two or more layers with joints staggered.
- h. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

#### 3.4.4 Equipment Handling Dual Temperature Media

Below and above 60 degrees F: equipment handling dual temperature media shall be insulated as specified for cold equipment.

#### 3.4.5 Equipment Exposed to Weather

##### 3.4.5.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

##### 3.4.5.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation and shall prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 250 pound walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet shall be aluminum and exposed fastenings shall be stainless steel or aluminum.

-- End of Section --

## SECTION 15181A

CHILLED AND CONDENSER WATER PIPING AND ACCESSORIES  
02/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22 (1999; 2001) Relief Valves for Hot Water Supply Systems

## ASTM INTERNATIONAL (ASTM)

ASTM A 106 (1999e1) Seamless Carbon Steel Pipe for High-Temperature Service

ASTM A 182/A 182M (2001a) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

ASTM A 183 (1998) Carbon Steel Track Bolts and Nuts

ASTM A 193/A 193M (2001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

ASTM A 47/A 47M (1999) Ferritic Malleable Iron Castings

ASTM A 53/A 53M (2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 536 (1984; R 1999e1) Ductile Iron Castings

ASTM A 653/A 653M (2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 733 (2001) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

ASTM B 117 (1997) Operating Salt Spray (Fog) Apparatus

ASTM B 32 (2000) Solder Metal

ASTM B 62 (1993) Composition Bronze or Ounce Metal



## Castings

ASTM B 75	(1999) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 813	(2000) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B 88	(1999e1) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM D 1384	(2001) Corrosion Test for Engine Coolants in Glassware
ASTM D 2000	(2001) Rubber Products in Automotive Applications
ASTM D 3308	(2001) PTFE Resin Skived Tape
ASTM D 520	(2000) Zinc Dust Pigment
ASTM D 596	(2001) Reporting Results of Analysis of Water
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM F 1007	(1986; R 1996e1) Pipe-Line Expansion Joints of the Packed Slip Type for Marine Application
ASTM F 1120	(1987; R 1998) Circular Metallic Bellows Type Expansion Joints for Piping Applications
ASTM F 1199	(1988; R 1998) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)

## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1003	(2001) Water Pressure Reducing Valves
ASSE 1017	(1998) Temperature Actuated Mixing Valves for Hot Water Distribution Systems

## AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints
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## AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS BRH	(1991) Brazing Handbook
AWS D1.1/D1.1M	(2000) Structural Welding Code - Steel
AWS Z49.1	(1999) Safety in Welding, Cutting and Allied Processes

## ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.11	(2001) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2001) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2001) Power Piping
ASME B31.9	(1996) Building Services Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1

## - Basic Coverage

## EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds (1998; 7th Edition; Addenda 2000) EJMA Standards

## HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5 (1994) Centrifugal Pumps

## MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110 (1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

MSS SP-25 (1998) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-67 (2002) Butterfly Valves

MSS SP-69 (1996) Pipe Hangers and Supports - Selection and Application

MSS SP-70 (1998) Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 (1997) Gray Iron Swing Check Valves, Flanges and Threaded Ends

MSS SP-72 (1999) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-78 (1998) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

MSS SP-85 (1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1997) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA MG 1 (1998) Motors and Generators

NEMA MG 2 (2001) Safety Standard for Construction  
and Guide for Selection, Installation, and  
Use of Electric Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (1999) Installation of Air Conditioning  
and Ventilating Systems

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50541 (Basic) Valves, Tank Float, Angle and  
Globe Pattern (Inch-Pound

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

#### Piping System;

Drawings, at least 5 weeks prior to beginning construction, provided in adequate detail to demonstrate compliance with contract requirements. Drawings shall consist of:

- a. Piping layouts which identify all valves and fittings.
- b. Plans and elevations which identify clearances required for maintenance and operation.

### SD-03 Product Data

#### Materials and Equipment; G

Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures. Data shall be provided for the following components as a minimum:

- a. Piping and Fittings
- b. Valves and Accessories
- c. Expansion Joints

- d. Pumps and Pump Curves
- e. Expansion Tanks
- f. Air Separator Tanks
- g. Pipe Hangers, Inserts, and Supports

Water Treatment Systems; G

Six complete copies, at least 5 weeks prior to the purchase of the water treatment system, of the proposed water treatment plan including a layout, control scheme, a list of existing make-up water conditions including the items listed in paragraph "Water Analysis", a list of chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

Spare Parts;

Spare parts data for each different item of equipment specified.

Qualifications; G

Six copies of qualified procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations.

Field Tests;

A schedule, at least 2 weeks prior to the start of related testing, for each test. The schedules shall identify the proposed date, time, and location for each test.

Demonstrations;

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

Verification of Dimensions;

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found.

SD-06 Test Reports

Field Tests;

Six copies of the report shall be provided in bound 8 1/2 x 11 inch booklets. Reports shall document all phases of the tests performed. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.

## One-Year Inspection;

Six copies of an inspection report, at the completion of one year of service, in bound 8 1/2 x 11 inch booklets. The report shall identify the condition of each cooling tower and condenser. The report shall also include a comparison of the condition of the cooling tower and condenser with the manufacturer's recommended operating conditions. The report shall identify all actions taken by the Contractor and manufacturer to correct deficiencies during the first year of service.

## SD-07 Certificates

## Service Organization;

A certified list of qualified permanent service organizations, which includes their addresses and qualifications, for support of the equipment. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

## SD-10 Operation and Maintenance Data

## Operation Manuals;

Six complete copies of an operation manual in bound 8 1/2 x 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

## Maintenance Manuals;

Six complete copies of maintenance manual in bound 8 1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping layouts and simplified wiring and control diagrams of the system as installed.

## Water Treatment Systems;

Six complete copies of operating and maintenance manuals for the step-by-step water treatment procedures. The manuals shall include testing procedures used in determining water quality.

## 1.3 QUALIFICATIONS

Piping shall be welded in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures and

welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply the personally assigned symbol near each weld made, as a permanent record. Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL.

#### 1.4 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

#### 1.6 PROJECT/SITE CONDITIONS

##### 1.6.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

##### 1.6.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

##### 1.6.3 Spare Parts

The Contractor shall submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

## PART 2 PRODUCTS

## 2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations.

## 2.2 NAMEPLATES

Major equipment including pumps, pump motors, expansion tanks, and air separator tanks shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates shall be durable and legible throughout equipment life and made of stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

## 2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical characteristics shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and NEMA MG 2 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be continuous duty with the enclosure specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors shall be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors shall be sized for the applicable loads. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.



## 2.4 PIPING SYSTEM

System design, component selection, and system installation, including pressure containing parts and material, shall be based upon a minimum service pressure of 125 psi at 150 degrees F; minimum ANSI Class 125. Chilled and condenser water piping shall be steel pipe with the exception that piping 4 inches and smaller may be copper tubing.

## 2.5 STEEL PIPE

Steel pipe shall conform to ASTM A 53/A 53M, Schedule 40, Type E or S, Grades A or B. Type F pipe shall not be used.

### 2.5.1 Fittings and End Connections (Joints)

Fittings and end connections shall be as defined herein, except as identified elsewhere. Piping and fittings 1 inch and smaller shall have threaded connections. Piping and fittings larger than 1 inch and smaller than 3 inches shall have either threaded, grooved, or welded connections. Piping and fittings 3 inches and larger shall have grooved, welded, or flanged connections. Rigid grooved mechanical connections may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 230 degrees F. Flexible grooved connections shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein. The manufacturer of each fitting shall be permanently identified on the body of the fitting in accordance with MSS SP-25.

#### 2.5.1.1 Threaded Connections

Threaded valves and pipe connections shall conform to ASME B1.20.1. Threaded fitting shall conform to ASME B16.3. Threaded unions shall conform to ASME B16.39. Threaded pipe nipples shall conform to ASTM A 733.

#### 2.5.1.2 Flanged Connections

Flanges shall conform to ASTM A 182/A 182M and ASME B16.5, Class 150. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. These gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.5. Bolts shall be high or intermediate strength material conforming to ASTM A 193/A 193M.

#### 2.5.1.3 Welded Connections

Welded valves and pipe connections (both butt-welds and socket-welds types) shall conform to ASME B31.9. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11. Welded fittings shall be identified with the appropriate grade and marking symbol.

#### 2.5.1.4 Grooved Mechanical Connections

Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12; or steel conforming ASTM A 106, Grade B or ASTM A 53/A 53M. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 Grade No. 2CA615A15B44F17Z for circulating medium up to 230 degrees F or Grade No. M3BA610A15B44Z for circulating medium up to 200 degrees F. Grooved mechanical connections shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183. Pipe connections and fittings shall be the product of the same manufacturer.

#### 2.5.1.5 Dielectric Waterways and Flanges

Dielectric waterways shall have a water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test. Dielectric waterways shall be constructed of galvanized steel and have threaded end connections to match connecting piping. Dielectric waterways shall be suitable for the required operating pressures and temperatures. Dielectric flanges shall provide the same pressure ratings as standard flanges and provide complete electrical isolation between connecting pipe and/or equipment as described herein for dielectric waterways.

### 2.6 COPPER PIPE

Copper pipe shall conform to ASTM B 88, Type K or L.

#### 2.6.1 Fittings and End Connections (Joints)

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

##### 2.6.1.1 Grooved Mechanical Connections

Grooved mechanical joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 230 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183. Pipe connections and fittings shall be the product of the same manufacturer.

### 2.6.2 Solder

Solder shall conform to ASTM B 32, grade Sb5, tin-antimony alloy for service pressures up to 150 psig. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

### 2.6.3 Brazing Filler Metal

Filler metal shall conform to AWS A5.8, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

## 2.7 VALVES

Valves shall meet the material, fabrication and operating requirements of ASME B31.1. Chain operators shall be provided for valves located 10 feet or higher above the floor. Valves in sizes larger than 1 inch and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be provided by the same manufacturer as the grooved pipe joint and fitting system.

### 2.7.1 Gate Valve

Gate valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with rising stem and threaded, soldered, or flanged ends. Gate valves 3 inches and larger shall conform to MSS SP-70, Type I, II, Class 125, Design OF and shall be cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

### 2.7.2 Globe and Angle Valve

Globe and angle valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Globe and angle valves 3 inches and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged or threaded ends.

### 2.7.3 Check Valve

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Check valves 3 inches and larger shall conform to MSS SP-71, Type I, II, III, or IV, Class 125 or 150 and shall be cast iron with bronze trim and flanged or threaded ends.

### 2.7.4 Butterfly Valve

Butterfly valves shall be in accordance with MSS SP-67, Type 1 and shall be either the wafer or lug type. Valves shall be bubble tight at 150 \_\_\_\_ or 250 psig. Valve bodies shall be cast iron, malleable iron, or steel. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

#### 2.7.5 Plug Valve

Plug valves 2 inches and larger shall conform to MSS SP-78, have flanged or threaded ends, and have cast iron bodies with bronze trim. Valves 2 inches and smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valve shall be lubricated, non-lubricated, or tetrafluoroethylene resin-coated type. Valve shall be resilient, double seated, trunnion mounted with tapered lift plug capable of 2-way shutoff. Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valve shall have weatherproof operators with mechanical position indicators. Valves 8 inches or larger shall be provided with manual gear operators with position indicators.

#### 2.7.6 Ball Valve

Ball valves 1/2 inch and larger shall conform to MSS SP-72 or MSS SP-110 and shall be ductile iron or bronze with threaded, soldered, or flanged ends. Valves 8 inches or larger shall be provided with manual gear operators with position indicators.

#### 2.7.7 Calibrated Balancing Valve

Valve shall be calibrated so that flow can be determined when the temperature and pressure differential across valve is known. Valve shall have an integral pointer which registers the degree of valve opening. Valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valve's Cv rating shall be as indicated. Valve bodies shall be provided with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter, suitable for the operating pressure specified, shall be provided. The meter shall be complete with hoses, vent, integral metering connections, and carrying case as recommended by the valve manufacturer. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

#### 2.7.8 Automatic Flow Control Valve

Valve shall automatically maintain a constant flow as indicated. Valve shall modulate by sensing the pressure differential across the valve body. Valve shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valve shall control the flow within 5 percent of the tag rating. Valve materials shall be the same as specified for the ball or plug valves. Valve Cv rating shall be as indicated. Valve operators shall be the electric or pneumatic type as indicated. Valve shall be capable of positive shutoff against the system pump head, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings and

differential meter, suitable for the operating pressure specified. The meter shall be complete with hoses, vent, integral metering connections, and carrying case as recommended by the valve manufacturer.

#### 2.7.9 Pump Discharge Valve

Valve shall perform the functions of a nonslam check valve, a manual balancing valve, and a shutoff. Valve shall be of cast iron or ductile iron construction with bronze and/or stainless steel accessories. Valve shall have an integral pointer which registers the degree of valve opening.

Flow through the valve shall be manually adjustable from bubble tight shutoff to full flow. Valves smaller than 2 inches shall have NPT connections. Valves 2 inches and larger shall have flanged or grooved end connections. Valve design shall allow the back seat for the stem to be replaced in the field under full line pressure. Valve's Cv rating shall be as indicated.

#### 2.7.10 Temperature-Mixing Valve

Valve shall be in accordance with ASSE 1017 for water service.

#### 2.7.11 Pressure-Reducing Valve

Valve shall be in accordance with ASSE 1003 for water service.

#### 2.7.12 Pressure Relief Valve

Valve shall prevent excessive pressure in the piping system when the piping system reaches its maximum heat buildup. Valve shall be in accordance with ANSI Z21.22 and shall have cast iron bodies with corrosion resistant internal working parts. The discharge pipe from the relief valve shall be the size of the valve outlet unless otherwise indicated.

#### 2.7.13 Drain Valves

Valves shall be the gate valve type which are in accordance with MSS SP-80.

Valve shall be manually-operated, 3/4 inch pipe size and above with a threaded end connection. Valve shall be provided with a water hose nipple adapter. Frost-free type valves shall be provided in installations exposed to freezing temperatures.

#### 2.7.14 Air Vents

Manually-operated general service type air vents shall be brass or bronze valves which are furnished with threaded plugs or caps. Automatic type air vents shall be the ball-float type with brass/bronze or brass bodies, 300 series corrosion-resistant steel float, linkage and removable seat. Air vents on water coils shall have not less than 1/8 inch threaded end connections. Air vents on water mains shall have not less than 3/4 inch threaded end connections. Air vents on all other applications shall have not less than 1/2 inch threaded end connections.

## 2.8 PIPING ACCESSORIES

### 2.8.1 Strainer

Strainer shall be in accordance with ASTM F 1199, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. Strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Strainer shall be equipped with removable cover and sediment screen. The screen shall be made of minimum 22 gauge corrosion-resistant steel, with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

### 2.8.2 Combination Strainer and Suction Diffuser

Unit shall consist of an angle type body with removable strainer basket and straightening vanes, a suction pipe support, and a blowdown outlet. Strainer shall be in accordance with ASTM F 1199, except as modified herein. Unit body shall have arrows clearly cast on the sides indicating the direction of flow. Strainer screen shall be made of minimum 22 gauge corrosion-resistant steel, with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. Flow shall be into the screen and out through the perforations.

### 2.8.3 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psig or 150 psig service as appropriate for the static head plus the system head, and 230 degrees F, for grooved end flexible connectors. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. The flexible section shall be suitable for intended service with end connections to match adjacent piping. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

### 2.8.4 Pressure and Vacuum Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 3-1/2 inches in diameter with a range from 0 psig to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

#### 2.8.5 Temperature Gauges

Temperature gauges shall be the industrial duty type and be provided for the required temperature range. Gauges shall have Fahrenheit scale in 2 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 5 feet of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 5 to 7 feet above the finished floor. Remote element type temperature gauges shall be provided in thermal wells located 7 feet above the finished floor.

##### 2.8.5.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

##### 2.8.5.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 3-1/2 inches, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment. Accuracy shall be one percent of dial range.

##### 2.8.5.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

##### 2.8.5.4 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

#### 2.8.6 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports shall conform to MSS SP-58 and MSS SP-69.

#### 2.8.7 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

## 2.9 PUMPS

Pumps shall be the electrically driven, non-overloading, centrifugal type which conform to HI 1.1-1.5. Pump capacity, efficiency, motor size, and impeller type shall be as indicated on the drawings. Pumps shall be selected at or within 5 percent of peak efficiency. Pump curve shall rise continuously from maximum capacity to shutoff. Pump motor shall conform to NEMA MG 1, be totally enclosed, and have sufficient horsepower for the service required. Pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in the cover.

### 2.9.1 Construction

Shaft seal shall be mechanical-seal. Impeller shall be statically and dynamically balanced. Each pump casing shall be designed to withstand the discharge head specified plus the static head on system plus 50 percent of the total, but not less than 125 psig. Pump casing and bearing housing shall be close grained cast iron. High points in the casing shall be provided with manual air vents; low points shall be provided with drain plugs. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Shaft shall be carbon or alloy steel, turned and ground. Bearings shall be ball-bearings, roller-bearings, or oil-lubricated bronze-sleeve type bearings, and be efficiently sealed or isolated to prevent loss of oil or entrance of dirt or water. Pump and motor shall be mounted on a common cast iron base having lipped edges and tapped drainage openings or structural steel base with lipped edges or drain pan and tapped drainage openings. Pump shall be provided with shaft coupling guard. Close coupled pumps shall be provided with drip pockets and tapped openings. Pump motor shall have the required capacity to prevent overloading with pump operating at any point on its characteristic curve. Pump speed shall not exceed 3,600 rpm, except where the pump head is less than 60 feet of water, the pump speed shall not exceed 1,750 rpm. Pump shall be accessible for servicing without disturbing piping connections.

### 2.9.2 Mechanical Shaft Seals

Seals shall be single, inside mounted, end-face-elastomer bellows type with stainless steel spring, brass or stainless steel seal head, carbon rotating face, and tungsten carbide or ceramic sealing face. Glands shall be bronze and of the water-flush design to provide lubrication flush across the face of the seal. Bypass line from pump discharge to flush connection in gland shall be provided, with filter or cyclone separator in line.

## 2.10 EXPANSION TANKS

Tank shall be welded steel, constructed, tested and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psig and precharged to the minimum operating pressure. Tank shall have a replaceable diaphragm and be the captive air type. Tanks shall accommodate expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. Each tank air chamber shall be fitted with a drain, fill, an air charging valve, and



system connections. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The only air in the system shall be the permanent sealed-in air cushion contained within the expansion tank.

## 2.11 AIR SEPARATOR TANKS

External air separation tank shall have an internal design suitable for creating the required vortex and subsequent air separation. Tank shall be steel, constructed, tested, and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psig. Tank shall have tangential inlets and outlets connections, threaded for 2 inches and smaller and flanged for sizes 2 1/2 inches and larger. Air released from a tank shall be to the atmosphere \_\_\_ or vented as indicated. Tank shall be provided with a blow-down connection.

## 2.12 WATER TREATMENT SYSTEMS

When water treatment is specified, the use of chemical-treatment products containing hexavalent chromium (Cr) is prohibited.

### 2.12.1 Water Analysis

Conditions of make-up water to be supplied to the chilled water systems were reported in accordance with ASTM D 596 and are as follows:

Date of Sample	_____
Temperature	_____ degrees F.
Silica (SiO <sub>2</sub> )	_____ ppm (mg/l)
Insoluble	_____ ppm (mg/l)
Iron and Aluminum Oxides	_____ ppm (mg/l)
Calcium (Ca)	_____ ppm (mg/l)
Magnesium (Mg)	_____ ppm (mg/l)
Sodium and Potassium (Na and K)	_____ ppm (mg/l)
Carbonate (HCO <sub>3</sub> )	_____ ppm (mg/l)
Sulfate (SO <sub>4</sub> )	_____ ppm (mg/l)
Chloride (Cl)	_____ ppm (mg/l)
Nitrate (NO <sub>3</sub> )	_____ ppm (mg/l)
Turbidity	_____ unit
pH	_____
Residual Chlorine	_____ ppm (mg/l)
Total Alkalinity	_____ epm (meq/l)
Non-Carbonate Hardness	_____ epm (meq/l)
Total Hardness	_____ epm (meq/l)
Dissolved Solids	_____ ppm (mg/l)
Fluorine	_____ ppm (mg/l)
Conductivity	_____ micrmho/cm

### 2.12.2 Chilled and Condenser Water

Water to be used in the chilled water systems shall be treated to maintain the conditions recommended by this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Chemicals shall meet all required federal, state, and local

environmental regulations for the treatment of evaporator coils and direct discharge to the sanitary sewer.

#### 2.12.3 Glycol Solution

A 30 percent concentration by volume of industrial grade ethylene glycol shall be provided in the chilled water. The glycol shall be tested in accordance with ASTM D 1384 with less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicate based inhibitors shall not be used. The solution shall be compatible with pump seals, other elements of the system, and water treatment chemicals used within the system.

#### 2.12.4 Water Treatment Services

The services of a company regularly engaged in the treatment of chilled water systems shall be used to determine the correct chemicals required, the concentrations required, and the water treatment equipment sizes and flow rates required. The company shall maintain the chemical treatment and provide all chemicals required for the chilled water systems for a period of 1 year from the date of occupancy. The chemical treatment and services provided over the 1 year period shall meet the requirements of this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Acid treatment and proprietary chemicals shall not be used.

#### 2.12.5 Chilled Water System

A shot feeder shall be provided on the chilled water piping as indicated. Size and capacity of feeder shall be based on local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

### 2.13 FABRICATION

#### 2.13.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand 125 hours exposure to the salt spray test specified in ASTM B 117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

#### 2.13.2 Factory Applied Insulation

Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no

higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

## 2.14 SUPPLEMENTAL COMPONENTS/SERVICES

### 2.14.1 Drain and Make-Up Water Piping

Piping and backflow preventers shall comply with the requirements of Section 15400A PLUMBING, GENERAL PURPOSE. Drains which connect to sanitary sewer system shall be connected by means of an indirect waste.

### 2.14.2 Field Applied Insulation

Field applied insulation shall be provided and installed in accordance with Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

#### 3.1.1 Directional Changes

Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

#### 3.1.2 Functional Requirements

Horizontal supply mains shall pitch down in the direction of flow as indicated. The grade shall not be less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt

or other foreign materials out of the system. Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 2-1/2 inches or less in diameter, and with flanges for pipe 3 inches and above in diameter. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric waterways or flanges. Piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Electric isolation fittings shall be provided between dissimilar metals.

### 3.1.3 Fittings and End Connections

#### 3.1.3.1 Threaded Connections

Threaded connections shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

#### 3.1.3.2 Brazed Connections

Brazing shall be performed in accordance with AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Brazing flux shall not be used. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Piping shall be supported prior to brazing and not be sprung or forced.

#### 3.1.3.3 Welded Connections

Branch connections shall be made with welding tees or forged welding branch outlets. Pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding, the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1/D1.1M or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

#### 3.1.3.4 Grooved Mechanical Connections

Grooves shall be prepared in accordance with the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer, or other method specifically approved

by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

#### 3.1.3.5 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

#### 3.1.3.6 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for the intended application.

#### 3.1.4 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

#### 3.1.5 Air Vents

Air vents shall be provided at all high points, on all water coils, and where indicated to ensure adequate venting of the piping system.

#### 3.1.6 Drains

Drains shall be provided at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

#### 3.1.7 Flexible Pipe Connectors

Connectors shall be attached to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.

#### 3.1.8 Temperature Gauges

Temperature gauges shall be located on coolant supply and return piping at

each heat exchanger, on condenser water piping entering and leaving a condenser, at each automatic temperature control device without an integral thermometer, and where indicated or required for proper operation of equipment. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch.

#### 3.1.9 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

##### 3.1.9.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

##### 3.1.9.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

##### 3.1.9.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

##### 3.1.9.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

##### 3.1.9.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

##### 3.1.9.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Pipe hanger loads suspended from steel joist

with hanger loads between panel points in excess of 50 pounds shall have the excess hanger loads suspended from panel points.

#### 3.1.9.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

#### 3.1.9.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

#### 3.1.9.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle shall be used. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

#### 3.1.9.10 High Temperature Guides with Cradles

Where there are high system temperatures and welding to piping is not desirable, then the Type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches, or by an amount adequate for the insulation, whichever is greater.

#### 3.1.9.11 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

#### 3.1.9.12 Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified under Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT as shown on the drawings. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05120 STRUCTURAL STEEL.

#### 3.1.9.13 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and

anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be as specified under Section 05120 STRUCTURAL STEEL.

#### 3.1.10 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

#### 3.1.11 Pipe Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, these items shall be anchored immediately adjacent to each penetrated surface, to provide essentially zero movement within penetration seal. Detailed drawings of pipe anchors shall be submitted for approval before installation.

#### 3.1.12 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 653/A 653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53/A 53M, Schedule 30 or \_\_\_\_ Schedule 20 \_\_\_\_ or Standard weight. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

##### 3.1.12.1 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07900A JOINT SEALING.



### 3.1.12.2 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

- a. Waterproofing Clamping Flange: Pipes up to and including 10 inches in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.
- b. Modular Mechanical Type Sealing Assembly: In lieu of a waterproofing clamping flange, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

### 3.1.12.3 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07840A FIRESTOPPING.

### 3.1.12.4 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

### 3.1.13 Pumps

Support, anchor, and guide so that no strains are imposed on pump by weight or thermal movement of piping. Air vents on pump casings shall be provided. Drain outlets on pump bases shall be piped to the nearest floor or other acceptable drains, with necessary clean-out tees.

### 3.1.14 Access Panels

Access panels shall be provided for all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500A MISCELLANEOUS METAL.

### 3.1.15 Field Applied Insulation

Field installed insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

### 3.1.16 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09900 PAINTING, GENERAL.

#### 3.1.16.1 Color Coding

Color coding for piping identification is specified in Section 09900 PAINTING, GENERAL.

#### 3.1.16.2 Color Coding Scheme

A color coding scheme for locating hidden piping shall be in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

## 3.2 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from all water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

## 3.3 FIELD TESTS

Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test

shall be provided by the Contractor. The services of a qualified technician shall be provided as required to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

### 3.3.1 Hydrostatic Tests

Following the cleaning procedures defined above, all chilled and condenser water piping systems shall be hydrostatically tested as defined herein. Unless otherwise agreed by the Contracting Officer, water (or glycol solution) shall be the test medium.

#### 3.3.1.1 Equipment and Component Isolation

Prior to testing, equipment and components that cannot withstand the test pressure shall be properly isolated.

#### 3.3.1.2 Tests

Piping shall be hydrostatically tested at a pressure equal to 150 percent of the total system operating pressure for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Test pressure shall be monitored by a calibrated, test pressure gauge. Leaks shall be repaired and piping retested until test is successful. No loss of pressure shall be allowed. Leaks shall be repaired by rewelding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before concealing.

### 3.3.2 Backflow Prevention Assemblies Tests

Backflow prevention assemblies shall be tested in accordance with Section 15400A PLUMBING, GENERAL PURPOSE.

### 3.3.3 Condenser Water Quality Tests

The condenser water shall be analyzed a minimum of once a month for a period of one year by the water treatment company. The analysis shall include the following information recorded in accordance with ASTM D 596.

Date of Sample	_____	
Temperature	_____	degrees F.
Silica (SiO <sub>2</sub> )	_____	ppm (mg/l)
Insoluble	_____	ppm (mg/l)
Iron and Aluminum Oxides	_____	ppm (mg/l)
Calcium (Ca)	_____	ppm (mg/l)
Magnesium (Mg)	_____	ppm (mg/l)
Sodium and Potassium (Na and K)	_____	ppm (mg/l)
Carbonate (HCO <sub>3</sub> )	_____	ppm (mg/l)
Sulfate (SO <sub>4</sub> )	_____	ppm (mg/l)
Chloride (Cl)	_____	ppm (mg/l)
Nitrate (NO <sub>3</sub> )	_____	ppm (mg/l)
Turbidity	_____	unit
pH	_____	
Residual Chlorine	_____	ppm (mg/l)

Total Alkalinity	_____	epm (meq/l)
Non-Carbonate Hardness	_____	epm (meq/l)
Total Hardness	_____	epm (meq/l)
Dissolved Solids	_____	ppm (mg/l)
Fluorine	_____	ppm (mg/l)
Conductivity	_____	micrmho/cm

### 3.4 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff, as designated by the Contracting Officer, in accordance with the approved Operation Manuals. The training period shall consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The field posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

### 3.5 ONE-YEAR INSPECTION

At the conclusion of the one year period, each connecting liquid chiller condenser shall be inspected for problems due to corrosion, scale, and biological growth. If the equipment is found not to conform to the manufacturers recommended conditions, and the water treatment company recommendations have been followed; the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

-- End of Section --

## SECTION 15185N

LOW TEMPERATURE WATER (LTW) HEATING SYSTEM  
08/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ANSI B16.24	(1991; Errata 1991) Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500
ANSI S1.4	(1983; R 2001) Sound Level Meters

## ASME INTERNATIONAL (ASME)

ASME B1.1	(1989; R 2001) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(2002) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.34	(1996) Valves Flanged, Threaded, and Welding End

ASME B16.36	(1996) Orifice Flanges
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts
ASME B31.9	(1996) Building Services Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1003	(2001) Water Pressure Reducing Valves
ASSE 1017	(1998) Temperature Actuated Mixing Valves for Hot Water Distribution Systems

## ASTM INTERNATIONAL (ASTM)

ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 194/A 194M	(2001a) Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service or Both
ASTM A 307	(2002) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM B 32	(2000e1) Solder Metal
ASTM B 88	(2002) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM D 1785	(1999) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(2001) Rubber Products in Automotive

## Applications

ASTM F 1007 (1986; R 2002) Pipe Line Expansion Joints  
of the Packed Slip Type for Marine  
Application

ASTM F 1120 (1987; R 1998) Circular Metallic Bellows  
Type Expansion Joints for Piping  
Applications

## AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1 (1999) Safety in Welding, Cutting and  
Allied Processes

## COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015 (1994; R 1995) Copper Tube Handbook

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.144 Safety Color Code for Marking Physical  
Hazards

29 CFR 1910.219 Mechanical Power Transmission Apparatus

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-1689 (Rev. B) Tape, Pressure-Sensitive  
Adhesive, (Plastic Film)

FS A-A-50543 Heaters, Convection, Steam or Hot Water

FS A-A-50544 Radiators, Heating, Steam and Hot Water,  
Cast Iron

FS A-A-50545 Radiator, Heating, Baseboard Panel, Steam  
and Hot Water

FS A-A-50560 Pumps, Centrifugal, Water Circulating,  
Electric-Motor-Driven

FS WW-H-191 (Rev. D) Heater, Fluid, Industrial  
(Instantaneous, Steam, Water Convertor  
Type)

FS WW-U-516 (Rev. B) Unions, Brass or Bronze, Threaded  
Pipe Connections and Solder-Joint Tube  
Connections

FS WW-S-2739 Strainers, Sediment: Pipeline, Water,  
Air, Gas, Oil, or Steam

FS S-R-2834 Radiators: Heating, Steel, Multifin Type

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH  
(FCCCHR)

FCCCHR List (continuously updated) List of Approved  
Backflow Prevention Assemblies

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-V-12003 (Rev. F; Am. 1) Valves, Plug: Cast Iron  
or Steel, Manually Operated

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports -  
Materials, Design and Manufacture

MSS SP-67 (2002) Butterfly Valves

MSS SP-69 (2002) Pipe Hangers and Supports -  
Selection and Application

MSS SP-70 (1998) Cast Iron Gate Valves, Flanged and  
Threaded Ends

MSS SP-71 (1997) Gray Iron Swing Check Valves,  
Flanged and Threaded Ends

MSS SP-72 (1999) Ball Valves with Flanged or  
Butt-Welding Ends for General Service

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check  
Valves

MSS SP-85 (1994) Cast Iron Globe & Angle Valves,  
Flanged and Threaded Ends

MSS SP-110 (1996) Ball Valves Threaded,  
Socket-Welding, Solder Joint, Grooved and  
Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2 (2002) Industrial Controls and Systems  
Controllers, Contactors, and Overload  
Relays Rated Not More Than 2,000 Volts AC  
or 750 Volts DC

NEMA ICS 6 (1993; R 2001) Industrial Control and  
Systems, Enclosures

NEMA MG 1 (1998) Motors and Generators



SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION  
(SMACNA)

SMACNA HVAC TAB

(1993; 3rd Printing 1999) HVAC Systems  
Testing, Adjusting and Balancing

1.2 RELATED REQUIREMENTS

Section 15050N, "Basic Mechanical Materials and Methods" applies to this section with additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Except as specified otherwise, equipment and piping components shall be suitable for use in low temperature water heating system. Except as modified herein, the pressure temperature limitations shall be as specified in the referenced standards and specifications. Pressures in this specification are pressures in pounds per square inch above atmospheric pressure, and temperatures are in degrees Fahrenheit (F).

1.3.1 Hot Water Heating System

Submit plan, elevations, dimensions, capacities, and ratings. Include the following:

- a. Unit heaters
- b. Convectors
- c. Finned tube radiators
- d. Pumps
- e. Valves
- f. Expansion tanks
- g. Flow measuring equipment
- h. Backflow preventer
- i. Air separating tank
- j. Converters

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hot water heating system

SD-03 Product Data

Convectors

Finned tube radiators

Pumps

Include pump speed and characteristic curve for performance of impeller selected for each pump. Curves shall indicate capacity vs head, efficiency, and brake power for full range, from shut-off to free delivery.

Expansion tanks

Flow measuring equipment

Backflow preventers

External air separation tanks

Hot water heating pipe

SD-06 Test Reports

Hydrostatic test of piping system

Auxiliary equipment and accessory tests

Submit test reports in accordance with the paragraph entitled "Field Quality Control."

SD-07 Certificates

Backflow preventer certification

Report of prior installations

Welding procedures

Welder's qualifications

SD-10 Operation and Maintenance Data

Convectors, Data Package 3; G

Finned tube radiators, Data Package 3; G

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data." Submit a list of qualified service organizations which includes addresses and qualifications.

## 1.5 QUALITY ASSURANCE

### 1.5.1 Standard Commercial Product for Terminal Units

Terminal units provided shall comply with features called out in this specification and shall be the manufacturer's standard commercial product. Additional or better features which are not prohibited by this specification but which are a part of the manufacturer's standard commercial product, shall be included in the terminal units being furnished. A standard commercial product is a product which has been sold or is currently being offered for sale, on the commercial market through advertisements or manufacturer's catalogs, or brochures. Provide Institute of Boiler and Radiator Manufacturer (IBR) or Steel Boiler Institute (SBI) rating for required capacity.

### 1.5.2 Welding

#### 1.5.2.1 Report of Prior Installations

Submit a Certificate of Full Approval or a current Certificate of Approval for each design, size, and make of backflow preventer being provided for the project. Certificate shall be from the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California, and shall attest that this design, size, and make of backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. A Certificate of Provisional Approval is not acceptable in lieu of the above.

#### 1.5.2.2 Welding Procedures

Before performing welding, submit three copies of welding procedure specification for all metals to be used in the work, together with proof of welder's qualification as outlines in ASME B31.9.

#### 1.5.2.3 Welder's Qualifications

Before welder or operator performs welding, submit three copies of Welder's Performance Qualification Record in conformance with ASME B31.9 showing that the welder was tested under the approved procedure specification submitted by the Contractor. In addition, submit each welder's assigned number, letter, or symbol used to identify the work of the welder.

#### 1.5.2.4 Identification of Welder's Work

Ensure that each welder's assigned number, letter or symbol is affixed immediately upon completion of the weld. To welders making defective welds after passing a qualification test, give a requalification test. Upon failing to pass the test, do not permit welder to work in this contract.

#### 1.5.2.5 Previous Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without requalification subject to the approval and provided that all the conditions specified in ASME B31.9 are met before a procedure can be used.

#### 1.5.3 Brazing and Soldering

##### 1.5.3.1 Brazing Procedure

ASME B31.9. Brazing procedure for joints shall be as outlined in CDA A4015.

##### 1.5.3.2 Soldering, Soldering Preparation, and Procedures for Joints

ASME B31.9 and as outlined in CDA A4015.

#### 1.5.4 Backflow Preventer Certification

Submit a Certificate of Full Approval or a current Certificate of Approval for backflow preventers.

### 1.6 SAFETY STANDARDS

#### 1.6.1 Welding

Safety in welding and cutting of pipe shall conform to AWS Z49.1.

#### 1.6.2 Guards

Couplings, motor shafts, gears and other moving parts shall be guarded, in accordance with OSHA 29 CFR 1910.219. Guards shall be cast iron or expanded metal. Guard parts shall be rigid and removable without disassembling the guarded unit.

## PART 2 PRODUCTS

### 2.1 PIPE AND FITTINGS

#### 2.1.1 Hot Water Heating Pipe (Supply and Return)

ASTM A 53/A 53M electric resistance welded or seamless Schedule 40 steel pipe or ASTM B 88 Type K hard drawn Copper tubing.

#### 2.1.2 Fittings

Provide fittings compatible with the pipe being provided and shall conform to the following requirements.

##### 2.1.2.1 Steel or Malleable Iron Pipe

Sizes 1/8 to 2 inches. ASME B16.11 steel socket welding or screwed type or ASME B16.3 for screwed type malleable iron fittings.

#### 2.1.2.2 Steel, Cast Iron, or Bronze

Sizes 2 1/2 inches and above. Steel fitting butt welding type ASME B16.9 or ASME B16.5 flanged type. Cast iron fittings flanged type ASME B16.1. Bronze fittings up to 8 inch size flanged type ANSI B16.24.

#### 2.1.2.3 Fittings for Copper Tubing

ANSI B16.18 cast bronze solder joint type or ASME B16.22 wrought copper solder joint type. Fittings may be flared or compression joint type.

#### 2.1.3 Mechanical Pipe Coupling System

Couplings may be provided for water temperatures not to exceed 200 degrees F.

Couplings shall be self centering and shall engage and lock in place the grooved or shouldered ends of pipe and pipe fittings in a positive watertight couple. Couplings shall be designed to permit some angular pipe deflection, contraction, and expansion. Coupling clamp shall be ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be molded rubber conforming to ASTM D 2000, the "line call-out" number shall be suitable for a water temperature of 230 degrees F. Coupling nuts and bolts shall be steel conforming to ASTM A 183. Fittings shall be grooved malleable iron conforming to ASTM A 47/A 47M, Grade 32510 or ductile iron conforming to ASTM A 536, Grade 65-45-12 or malleable iron conforming to ASTM A 47/A 47M, Grade 32510. Mechanical couplings and fittings shall be of the same manufacturer. Before assembling couplings, coat pipe ends and outsides of gaskets with lubricant approved by the coupling manufacturer to facilitate installation.

##### 2.1.3.1 Groove and Check Valves

Grooved end, dual disc, spring loaded, non-slam check valves with Type 316 stainless steel or aluminum bronze discs and EPDM rubber seats. Maximum rated working pressure of 500 psi dependent on size. Tested in accordance with MSS SP-71.

##### 2.1.3.2 Butterfly Valves

Grooved end butterfly valves with ductile iron body and disc core to ASTM A 536. Disc rubber connected with EPDM rubber. Maximum rated working pressure of 300 psi tested in accordance with MSS SP-67.

##### 2.1.3.3 Strainers

Include grooved end T-type strainers with steel or ductile iron bodies, Type 304 removable strainer baskets with 6 or 12 mesh screens and 57 percent open area. Maximum rated working pressure of 750 psi dependent on size.

#### 2.1.4 Unions

##### 2.1.4.1 Steel Pipe

Provide ASME B16.39, malleable iron unions, threaded connections.

##### 2.1.4.2 Copper Tubing

Provide FS WW-U-516, bronze unions, solder joint end.

##### 2.1.4.3 Dielectric Union

Provide insulated union with galvanized steel female pipe-threaded end and a copper solder joint end conforming with ASME B16.39, Class 1, dimensional, strength and pressure requirements. Union shall have a water-impervious insulation barrier capable of limiting galvanic current to one percent of the short-circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test.

#### 2.1.5 Flanges

Remove raised faces when used with flanges having a flat face.

##### 2.1.5.1 Steel Flanges

ASME B16.5 forged steel, welding type.

##### 2.1.5.2 Cast Iron Screwed Flanges

ASME B16.1.

##### 2.1.5.3 Bronze Screwed Flanges

ANSI B16.24.

#### 2.1.6 Drains and Overflows

##### 2.1.6.1 Steel Pipe

ASTM A 53/A 53M, Electric resistance welded Schedule 40, Malleable iron or forged steel fittings, screwed or welded joints.

##### 2.1.6.2 Copper Tubing

ASTM B 88, Type K hard drawn, cast brass or wrought copper fittings, Grade Sb5 solder joints.

#### 2.1.7 Valves

Valves shall have rising stems and shall open when turned counterclockwise.

## 2.1.7.1 Gate Valves

- a. Bronze Gate Valves: MSS SP-80, 2 inches and smaller, wedge disc, inside screw type not less than Class 150. Use solder joint ends with copper tubing.
- b. Steel Gate Valves: ASME B16.34, provide with open stem and yoke type with solid wedge or flexible wedge disc and heat and corrosion-resistant steel trim.
- c. Cast Iron Gate Valves: MSS SP-70, 2 1/2 inches and larger, open stem and yoke type with bronze trim.

## 2.1.7.2 Globe and Angle Valves

- a. Bronze Globe and Angle Valves: MSS SP-80, 2 inches and smaller, Class 200, except use Class 150 with solder ends for copper tubing. Valves shall have renewable seat and discs except solder end valves which shall have integral seats.
- b. Steel Globe and Angle Valves: ASME B16.34, provide with heat and corrosion-resistant trim.
- c. Cast Iron Globe and Angle Valves: MSS SP-85, 2 1/2 inches and larger, with bronze trim, tapped drains and brass plug.

## 2.1.7.3 Check Valves

- a. Bronze Check Valves: MSS SP-80, 2 inches and smaller, regrinding swing check type, Class 200.
- b. Steel Swing Check Valves: ASME B16.34, regrinding swing check type, Class 200.
  - (1) Swing check valves shall have bolted caps.
  - (2) Steel Lift check valves 2 inches and smaller shall have bolted caps. Lift check valves 2 1/2 inches and larger shall have pressure seal caps.
- c. Cast Iron Check Valves: ASME B16.34, 2 1/2 inches and larger, bronze trim, non-slam, eccentric disc type for centrifugal pump discharge service.

## 2.1.7.4 Temperature Regulating Valves

Provide ASSE 1017 copper alloy body with adjustable range thermostat.

## 2.1.7.5 Water Pressure-Reducing Valves

ASSE 1003.

## 2.1.7.6 Plug Valves

MIL-V-12003, except that a replaceable valve seat will not be required.  
Type II - non-lubricated, lift-plug valves.

## 2.1.7.7 Ball Valves

Flanged or butt-welding ends ball valve shall conform to MSS SP-72, bronze.  
Threaded, socket-welding, solder joint, grooved and flared ends shall conform to MSS SP-110.

## 2.1.7.8 Radiator Valves

Radiator valves shall be angle or straightway pattern, with packed or packless bonnet shutoff globe type, designed especially for hot water heating system. Valve shall be constructed of brass or bronze or copper alloy conforming to ASTM specifications for materials with non-metallic renewable disc and plastic wheel handle for shutoff service.

## 2.1.7.9 Flow Control Balancing Valves

Copper alloy or cast iron body, copper alloy or stainless internal working parts, and integral pointer that indicates the degree of valve opening. Valves shall be suitable for 125 psig at 190 degrees F hot water. Valve shall function as a service valve when in fully closed position. Valve body shall have factory-installed tapings for differential pressure meter connections for verification of pressure differential across valve orifice. Meter connections shall have positive check valves or shutoff valves. Each valve shall have metal tag showing the gallons per minute flow for each differential pressure reading.

## 2.1.7.10 Butterfly Valves

Conform with MSS SP-67, Type I - Tight shut off valve, and flanged valve ends. Valve body material shall be cast iron \_\_\_\_ steel \_\_\_\_ or bronze and shall be bubble tight for shutoff at 150 psig. Flanged and flangeless type valves shall have Type 300 series corrosion resistant steel stems and corrosion resistant or bronze discs with molded elastomer disc seals. Flow conditions shall be for the regulation from maximum flow to complete shutoff by way of throttling effect. Valves shall be provided in closed system. Valves smaller than 8 inches shall have throttling handles. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and indicators. Valves shall have a minimum of 7 locking positions and shall be suitable for water temperatures up to 200 degrees F.

## 2.1.7.11 Butterfly Valves 2 Inches and Smaller

Valves shall be one-piece and three-piece design with male or female threaded or soldered end connections and shall be bubble tight for shutoff at 150 psig. Stem and disc assembly shall be of 300 series corrosion resistant steel. Disc seal assembly shall be of 300 series corrosion resistant steel. Disc seal shall be suitable for the liquid being used in the system in which the valve is to be installed. Valves shall be suitable



for water temperature up to 200 degrees F and shall be capable of operating at the rated pressure of 150 psig. Valves shall be designed for throttling service use by valve lever and indicator adjustment.

#### 2.1.7.12 Relief Valves

Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

#### 2.1.7.13 Valve Operating Mechanisms

Provide floor stands and chainwheels where indicated and as specified.

- a. Floor Stands: Construct for bolting to the floor and include an extension stem and an operating handwheel. Design an adequately supported and guided extension stems for connection to the valve stem by a sleeve coupling or universal joint. Floor stands shall be cast iron or steel. Handwheel shall identify rotation direction for closing the valve and shall be of such diameter as to permit operation of the valve with a force of not more than 40 pounds.
- b. Chainwheel Operator: Shall be fabricated of cast iron or steel and shall include a wheel, endless chain and a guide to keep the chain on the wheel. Provide galvanized steel endless chain extending to within 3 feet of the floor.

#### 2.1.7.14 Balancing Valves

Balancing valves shall be calibrated bronze body balancing valves with integral ball valve and venturi or valve orifice and valve body pressure taps for flow measurement based on differential pressure readings. Valve pressure taps and meter connections shall have seals and built-in check valves with threaded connections for a portable meter. Meter shall be provided by the same manufacturer and be capable of reading system pressures and shall meet the requirements of the paragraph entitled "Flow Measuring Equipment." Valves shall have internal seals to prevent leakage around rotating element and be suitable for full shut-off rated pressure. Valves shall have an operator with integral pointer and memory stop. Balancing valves shall be selected for the required flows as indicated on the plans.

#### 2.1.8 End Connections

##### 2.1.8.1 Flexible Connectors

Provide flexible pipe connectors on piping connected to equipment. Flexible section shall consist of rubber, tetrafluoroethylene resin, corrosion-resistant steel, bronze, monel, or galvanized steel. Material provided and configuration shall be suitable for pressure, vacuum, temperature, and circulating medium. Flexible section shall have threaded, welding, soldering, flanged or socket-weld ends and shall be suitable for service intended. Flexible section may be reinforced with metal retaining rings, with built-in braided wire reinforcement and restriction bolts or

with wire braid cover suitable for service intended.

#### 2.1.8.2 Steel Piping

Screwed or socket welded for 2 inches and smaller and flanged or butt welded for 2 1/2 inches and larger.

- a. Screwed Joints With Taper Threads: ASME B1.20.1.
- b. Flanged Joints: Bolting and gaskets shall be as follows:
  - (1) Bolting: Bolt and stud material ASTM A 307, Grade B, and nut material ASTM A 194/A 194M, Grade 2. Bolt, stud, and nut dimensions ASME B18.2.2 threads ASME B1.1 coarse type with Class 2A fit for bolts and studs, and Class 2B fit for nuts. Bolts or bolt studs shall extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Carbon steel bolts shall have American Standard regular square or heavy hexagon heads and shall have American Standard heavy semifinished hexagonal nuts conforming to ASME B18.2.2.
  - (2) Gaskets: ASME B16.21, Nonasbestos compressed material 1/16 inch thickness full face or self-centering flat ring type and suitable for pressure and temperature of the piping system.
- c. Butt Weld Joints: ASME B31.9. Backing rings shall conform to ASME B31.9. Ferrous rings shall not exceed 0.05 percent sulfur; for alloy pipe, backing rings shall be of material compatible with the chemical composition of the parts to be welded and preferably of the same composition. Provide continuous machined or split band backing rings.
- d. Socket Weld Joints: ASME B31.9.

#### 2.1.8.3 Joints for Copper Tubing

- a. Solder conforming to ASTM B 32 alloy grade Sb5 or Sn96. Solder and flux shall be lead free (less than 0.2 percent of lead).
- b. Copper Tube Extracted Joint: An extracted mechanical tee joint may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to assure a free flow joint. Braze extracted joints using a copper phosphorous classification brazing filler metal. Soldered joints shall not be permitted.

## 2.1.9 Instrumentation

## 2.1.9.1 Pressure and Vacuum Gauges

Provide ASME B40.1 with restrictor.

## 2.1.9.2 Indicating Thermometers

Thermometers shall be dial type with an adjustable angle suitable for the service. Provide thermowell sized for each thermometer in accordance with the thermowell specification. Fluid-filled thermometers (mercury is not acceptable) shall have a nominal scale diameter of 5 inches. Construction shall be stainless-steel case with molded glass cover, stainless-steel stem and bulb. Stem shall be straight, length as required to fit well. Bimetal thermometers shall have a scale diameter of 3 1/2 inches. Case shall be hermetic. Case and stem shall be constructed of stainless steel. Bimetal stem shall be straight and of a length as required to fit the well.

## 2.1.9.3 Pressure/Temperature Test Ports

Pressure/Temperature Test Ports shall have brass body and EPDM and/or Neoprene valve seals. Ports shall be rated for service between 35 and 275 degrees F and up to 500 psig. Ports shall be provided in lengths appropriate for the insulation thickness specified in Section 15080N, "Mechanical Insulation" and installed to allow a minimum of 12 inches of access for probe insertion. Provide with screw-on cap attached with a strap or chain to prevent loss when removed. Ports shall be 1/4 inch NPT and accept 1/8 inch diameter probes.

## 2.1.10 Miscellaneous Pipeline Components

## 2.1.10.1 Air Vent

Provide float type air vent in hydronic systems. Vent shall be constructed of brass or semi-steel body, copper float, and stainless steel valve and valve seat. Design air vent to suit system operating temperature and pressure. Provide isolating valve to permit service without draining the system. Pipe discharge of vent to a drain.

## 2.1.10.2 Strainers

Strainers for classes 125 and 250 piping in IPS 1/2 to 8 inches, inclusive, FS WW-S-2739 and locate as indicated.

## 2.1.10.3 Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments shall conform to MSS SP-58 and ASME B31.9. Hanger types and supports for bare and covered pipe shall conform to MSS SP-69 for the temperature range.

## 2.1.10.4 Pipe Sleeves

Sleeves in masonry and concrete walls, floors, and roof slabs shall be ASTM A 53/A 53M, Schedule 40 or Standard Weight, hot-dip galvanized steel,\_\_\_\_\_

ductile-iron or cast-iron pipe. Sleeves in partitions shall be zinc-coated sheet steel having a nominal weight of not less than 0.906 pound per square foot.

#### 2.1.10.5 Escutcheon Plates

Provide one piece or split hinge metal plates for piping passing through floors, walls, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces and paint finish on metal plates in unfinished spaces.

### 2.2 CENTRAL MECHANICAL EQUIPMENT

#### 2.2.1 Converters

Steam to hot water converters shall conform to FS WW-H-191 and shall have capacity as indicated for the design conditions. The converters shall be designed for support by separate pipe hangers, and temperature regulator and vent valve shall be provided.

### 2.3 PIPING SYSTEM EQUIPMENT

#### 2.3.1 Pumps

Provide hot water circulating pumps, FS A-A-50560, Service A. Pump casing and flange shall be made of close-grained cast iron. Shaft shall be carbon or alloy steel with lubricated bearings and impeller shall be bronze. Select pumps so that the operating point on selected impeller-curve will lie at or to the left of shutoff side of, and not more than 5 percent below, point of maximum efficiency for impeller. Provide motors of open totally enclosed type conforming to NEMA MG 1 and suitable for electrical characteristic as indicated. Motor starters shall conform to NEMA ICS 2 reduced-voltage-start type with NEMA ICS 6 weather-resistant enclosure.

#### 2.3.2 Expansion Tanks

Provide welded steel, constructed and tested hydrostatically in accordance with ASME BPVC SEC VIII D1. Tank shall be equipped with all necessary fittings. The tank and fittings shall be pressure rated at least equal to the test pressure of the total system. Zinc coat the tank inside and out after fabrication by the hot dip process ASTM A 123/A 123M.

#### 2.3.3 External Air Separation Tanks

Provide tank constructed of steel, designed for not less than 75 psig, and constructed and tested in accordance with the requirements of ASME BPVC SEC VIII D1. Provide tangential inlet and outlet connections, flanged for sizes 2 1/2 inches and larger. Each unit shall have an internal design suitable for creating the required vortex and subsequent air separation. Provide with automatic air release device and galvanized steel strainer. Provide a blow down connection with a gate valve and piped to nearest floor drain.

## 2.3.4 Backflow Preventers

Reduced pressure principle type. Furnish proof that each make, model/design, and size of backflow preventer being furnished for the project is approved by and has a current "Certificate of Approval" from the FCCCHR List or local code. Listing of a particular make, model/design, and size in the current FCCCHR List or local code will be acceptable as the required proof.

## 2.3.5 Flow Measuring Equipment

Orifice or venturi type. Flow metering equipment including pitot tubes, venturis, orifice plates, flanges, and indicating meters shall be the product of one and the same manufacturer. Provide flowmeters of portable type. Flowmeters shall be suitable for service in which they are to be installed. Primary elements of flowmeters shall conform to ASME recommendations for flowmeters. Provide bronze, monel, or stainless steel materials for wetted parts of flow meters.

- a. Orifices: Square-edge type, made of corrosion and erosion resistant metal and mounted between pipe flanges having factory-made pressure taps provided with shutoff valves. Orifice flanges shall conform to ASME B16.36.
- b. Tubular Flowmeters: Flow measuring elements consisting of venturi tubes or pitot tubes where indicated. Locations and arrangement of piping, both upstream and downstream of flow measuring elements shall conform to the manufacturer's published literature. Provide each flow measuring element with an integral tab, or a metal tag on a corrosion-resistant steel wire, extending outside pipe covering, and stamped or printed in a visible position with manufacturer's name and address; serial number of meter to which it is to be connected; name, number, or location of equipment served; specified rate of flow; and multiplier to be applied to meter reading. Provide taps with shutoff valves and quick connecting hose fittings for portable meters or double ferrule compression fittings for connection to tubing for permanently located meters or recorders. Tubes shall be calibrated in accordance with ASME recommendations.

(1) Venturi Tubes: Certified by the manufacturer for the actual piping configuration and any necessary piping changes required for certification without additional cost to the Government. Throat diameter for each venturi tube shall be designed so that at specified rate of flow the scale reading will fall between 50 percent and 80 percent of full scale value. Select venturi tube sizes from the manufacturer's latest published tables of flow versus differential pressure. Unrecovered head loss at maximum flow shall not exceed 10 percent. Provide bronze or cast iron tubes with bronze-lined throats, with flanged, threaded, or welded ends to suit piping system. Provide bodies of fabricated steel and fittings of the same class as piping in which installed. Two integral meter taps shall be provided in each venturi tube. Connections for attachment to portable flow meter hoses shall be

readily accessible and not over 6 feet above a floor or permanent platform.

(2) Pitot Tube Assemblies: Provide corrosion-resistant materials. Tubes shall be capable of measuring liquid flow through tube elements providing an averaged, interpolated flow measurement from a single, fixed position. Provide self cleaning elements and impact tube designed to rotate when turned by the operator to protect pressure-sensing elements of tube when not in use. Location and total amount of pitot tubes required for system flow measurement shall be as recommended by the manufacturer and as indicated.

- c. Meters: Designed for a full scale pressure differential of 50 inches water gage for tubular type or 100 inches water gage for orifice type. Dials shall have square root or linear scales with developed length of not less than 12 inches. Provide flush mounted panel meters that read directly in gallons per minute. Dials of portable meters shall have square root scales reading from 0 to 100 gpm for use with multiplier stamped on orifice or tubular type. Provide meters designed for not less than 200 psi and protected against pressure surges. Meter bodies shall have taps for venting and draining.

(1) Portable Meters: Provide meter with a factory-fabricated carrying case with carrying handle. Provide case fitted to hold meter securely and to accommodate the following accessories:

(a) Two 15 foot lengths of connecting hose with suitable female connectors for connecting from meter to \_\_\_\_\_venturi tube, orifice flange, pitot tube pressure-tap nipples. Provide hose designed for a minimum service pressure of 125 psi or 150 percent of maximum system service pressure, whichever is greater.

(b) A completely assembled three-valve manifold with two block valves and vent and drain valves, piped and mounted on a base designed for use laying flat on a stationary surface.

(c) A bound set of descriptive bulletins, installation and operating instructions, parts list, and a set of curves showing flow versus pressure differential for each orifice, venturi tube, or pitot tube with which meter is to be used.

(d) A metal instruction plate, secured inside cover, illustrating use of meter.

(e) Provide meters with overall accuracy of plus or minus 5 percent of full scale flow over a range from 20 to 100 percent of full scale flow.

## 2.4 TERMINAL UNITS

### 2.4.1 Finned Tube Radiators

Steel tube and steel fin type FS S-R-2834. Copper tube and aluminum fin type FS A-A-50545, shall have an adjustable damper.

### 2.4.2 Convectors

FS A-A-50543 and FS A-A-50544, of design and capacity not less than that indicated.

### 2.4.3 Unit Heaters

Provide hot water unit heaters as specified in Section 15760N, "Terminal Heating and Cooling Units."

### 2.4.4 Heating and Ventilating Units

Provide fan-coil units, induction units, unit ventilators, and gravity ventilators as specified in Section 15720N, "Air Handling Units."

## 2.5 ELECTRICAL EQUIPMENT

Provide complete with motors, motor starters, thermal overload protection, and controls. Equipment and wiring shall be in accordance with Section 16402N, "Interior Distribution System."

## 2.6 CONTROLS

Provide controls as specified in Section 15901N, "Space Temperature Control Systems."

## 2.7 INSULATION

Provide shop and field applied insulation as specified in Section 15080N, "Mechanical Insulation."

## 2.8 ASBESTOS PROHIBITION

Asbestos and asbestos containing products are prohibited.

## PART 3 EXECUTION

### 3.1 PREPARATION

Provide storage for equipment and material at the project site. All parts shall be readily accessible for inspection, repair, and renewal. Protect material and equipment from the weather.

### 3.2 INSTALLATION

Piping fabrication, assembly, welding, soldering, and brazing shall conform to ASME B31.9. Piping shall follow the general arrangement shown. Route

piping and equipment within buildings out of the way of lighting fixtures and doors, windows, and other openings. Run overhead piping in buildings in inconspicuous positions. Provide adequate clearances from walls, ceilings, and floors to permit welding of joints and application of insulation. Make provision for expansion and contraction of pipe lines. Make changes in size of water lines with reducing fittings. Do not bury, conceal, or insulate until piping has been inspected, tested, and approved.

Do not run piping concealed in walls, partitions, underground, or under the floor except as otherwise indicated. Where pipe passes through building structure, locate pipe joints and expansion joints where they may be inspected. Provide flanged joints where necessary for normal maintenance and where required to match valves and equipment. Furnish gaskets, packing, and thread compounds suitable for the service. Provide long radius ells where possible to reduce pressure drops. Pipe bends in lieu of welding fittings may be used where space permits. Pipe bends shall have a uniform radius of at least five times the pipe diameter and shall be free from appreciable flattening, wrinkling, or thinning of the pipe. Do not use mitering of pipe to form elbows, notching straight runs to form full sized tees, or any similar construction. Make branch connections over 2 inches with welding tees except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ASME B31.9 may be used, provided the nominal diameter of the branch is at least one pipe size less than the nominal diameter of the run. Branch connections 2 inches and under can be threaded or welded. Run vertical piping plumb and straight and parallel to walls. Provide sleeves for lines passing through building structure. Provide a fire seal where pipes pass through fire wall, fire partitions, fire rated pipe chase walls, or floors above grade. Install piping connected to equipment with flexibility for thermal stresses and for vibration, and support and anchor so that strain from weight and thermal movement of piping is not imposed on the equipment.

#### 3.2.1 Hangers and Supports

Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58. Band and secure insulation protection shields without damaging pipe insulation. Continuous inserts and expansion bolts may be used.

#### 3.2.2 Grading of Pipe Lines

Unless otherwise indicated, install horizontal lines of hot water piping to grade down in the direction of flow with a pitch of not less than one inch in 30 feet, except in loop mains and main headers where the flow may be in either direction.

#### 3.2.3 Pipe Sleeves

Provide sleeves where pipes and tubing pass through masonry or concrete walls, floors, roof, and partitions. Annular space between pipe, tubing, or insulation and the sleeve shall not be less than 1/4 inch. Hold sleeves securely in proper position and location before and during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs shall extend 2 inches above finished floor. Firmly pack space between pipe or tubing and sleeve



with oakum and caulk on both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material.

#### 3.2.4 Flashing for Buildings

Provide flashing where pipes pass through building roofs, and make outside walls tight and waterproof.

#### 3.2.5 Unions and Flanges

Provide unions and flanges to permit easy disconnection of piping and apparatus. Each connection having a screwed-end valve shall have a union. Place unions and flanges no farther apart than 100 feet. Install unions downstream of valves and at equipment or apparatus connections. Provide unions on piping under 2 inches in diameter, and provide flanges on piping 2 inches and over in diameter. Provide dielectric unions or flanges between ferrous and non-ferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or non-ferrous-to-non-ferrous connections.

#### 3.2.6 Connections for Future Equipment

Locate capped or plugged outlets for connections to future equipment as indicated.

#### 3.2.7 Changes in Pipe Size

Provide reducing fittings for changes in pipe size; reducing bushings are not permitted. In horizontal lines, provide eccentric reducing fittings to maintain the top of the lines in the same plane.

#### 3.2.8 Cleaning of Pipe

Thoroughly clean each section of pipe, fittings, and valves free of foreign matter before erection. Prior to erection, hold each piece of pipe in an inclined position and tap along its full length to loosen sand, mill scale and other foreign matter. For pipe 2 inches and larger, draw wire brush, of a diameter larger than that of the inside of the pipe, several times through the entire length of pipe. Before making final connections to apparatus, wash out interior of piping thoroughly with water. Plug or cap open ends of mains during shutdown periods. Do not leave lines open where foreign matter might enter the pipe.

#### 3.2.9 Valves

Install valves in conformance with ASME B31.9. Provide gate valves unless otherwise directed. Install valves with stems horizontal or above. Locate or equip stop valves to permit operation from floor level, or provide with safe access in the form of walkways or ladders. Install valves in positions accessible for operation and repair.

## 3.2.9.1 Globe Valves

Install globe valves so that the pressure is below the disk and the stem horizontal.

## 3.2.9.2 Radiators Valves

Provide radiator valves on water inlet and balancing valves on water outlet of terminal heating units such as radiation, unit heaters, and fan coil unit.

## 3.2.9.3 Relief Valves

Provide valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks. Select system relief valve so that capacity is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment. Pipe relief valve outlet to the nearest floor drain.

## 3.2.10 Pressure Gage

Provide a shut-off valve or pet cock between pressure gages and the line.

## 3.2.11 Thermometers

Provide thermometers and thermal sensing elements of control valves with a separable socket. Install separable sockets in pipe lines in such a manner to sense the temperature of flowing the fluid and minimize obstruction to flow.

## 3.2.12 Strainers

Provide strainers, with meshes suitable for the services, where indicated, or where dirt might interfere with the proper operation of valve parts, orifices, or moving parts of equipment.

## 3.2.13 Pumps

Select pumps for specified fluid temperatures, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve. Support piping adjacent to pump such that no weight is carried on pump casings. Install close coupled and base mounted pumps on concrete base, with anchor bolts, set and level, and grout in place and provide supports under elbows on pump suction and discharge line sizes 4 inches and over. Lubricate pump before start-up.

## 3.2.14 Equipment Foundations

Locate equipment foundations as shown on the drawings. Size, weight, and design shall preclude shifting of equipment under operating conditions. Foundations shall meet the requirements of the equipment manufacturer. Concrete shall conform to Section 03300N, "Cast-In-Place-Concrete," and grout shall be approved non-shrinking.

### 3.2.15 Equipment Installation

Install equipment in accordance with installation instructions of the manufacturers. Grout equipment mounted on concrete foundations before installing piping. Install piping in such a manner as not to place a strain on the equipment. Do not bolt flanged joints tight unless they match. Grade, anchor, guide, and support piping without low pockets.

### 3.2.16 Cleaning of Systems

As installation of the various system components is completed, fill, start, and vent prior to cleaning. Place terminal control valves in open position. Add cleaner to closed system at concentration as recommended by manufacturer. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water. Circulate for 6 hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed.

Use neutralizer agents on recommendation of system cleaner supplier and approval of Contracting Officer. Remove, clean, and replace strainer screens. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required. Preliminary or final tests are not permitted until cleaning is approved.

### 3.2.17 Painting of Piping and Equipment

Provide in accordance with Section 09900, "Paints and Coatings."

### 3.2.18 Identification of Piping

Identify piping in accordance with OSHA 29 CFR 1910.144, except that labels or tapes may be used in lieu of painting or stencilling. Spacing of identification marking on runs shall not exceed 50 feet. Materials for labels and tapes shall conform to FS A-A-1689, and shall be general purpose type and color class. Painting and stencilling shall conform to Section 09900, "Paints and Coatings."

## 3.3 FIELD QUALITY CONTROL

Perform inspections and tests as specified herein to demonstrate that piping and equipment, as installed, is in compliance with contract requirements. Start up and operate the system. During this time, periodically clean the various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of water occurs when strainers are cleaned. Adjust safety and automatic control instruments to place them in proper operation and sequence.

### 3.3.1 Hydrostatic Test of Piping System

Test piping system hydrostatically using water not exceeding 100 degrees F.

Conduct tests in accordance with the requirements of ASME B31.9 and as follows. Test piping system after all lines have been cleaned and before applying insulation covering. Remove or valve off from the system, gages,

and other apparatus which may be damaged by the test before the tests are made. Install calibrated test pressure gage in the system to observe any loss in pressure. Maintain test pressure for a sufficient length of time to enable an inspection of each joint and connection. Perform tests after installation and prior to acceptance. Notify the Contracting Officer in writing five days prior to the time scheduled for the tests.

### 3.3.2 Auxiliary Equipment and Accessory Tests

Observe and check pumps, accessories, and equipment during operational and capacity tests for leakage, malfunctions, defects, noncompliance with referenced standards, or overloading.

#### 3.3.2.1 Backflow Preventers

Backflow preventers shall be tested by locally approved and certified backflow assembly testers. A copy of the test report shall be provided to the Contracting Officer prior to placing the domestic water system into operation, or no later than 5 days after the test.

### 3.4 TESTING, ADJUSTING, AND BALANCING

Test, adjust, and balance the hydronic system in accordance with Section 15990A, "HVAC Testing/Adjusting/Balancing."

#### 3.4.1 Markings of Settings

Following final acceptance of the balancing report, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked so that adjustment can be restored if disturbed at anytime.

#### 3.4.2 Sound Level Tests

Upon completion of testing and balancing of hydronic systems, conduct sound level tests of conditioned spaces. Use sound level meter required by ANSI S1.4, Type 2, calibrated in accordance with NBS standards and guidelines, and accompanied by a certificate of calibration. Record sound levels in dBA with heating systems off and with heating systems operating. Record the following data for each room and system:

- a. Background sound level (systems off);
- b. Total sound level corrected for background; and
- c. Sound power rating by manufacturer of the respective outlet.

Test Locations: Take sound level reading at location 6 feet from face of each outlet on a line at 45 degrees with face of outlet. Remedial Action: If sound level at any observation point exceeds 45 dBA, take remedial action as directed.

-- End of Section --



## SECTION 15216N

WELDING PRESSURE PIPING  
**09/99**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN PETROLEUM INSTITUTE (API)

API Std 1104 (1994) Welding of Pipelines and Related Facilities

## ASME INTERNATIONAL (ASME)

ASME B31.1 (1995) Power Piping

ASME B31.3 (1996) Process Piping

ASME B31.4 (1992) Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols

ASME B31.5 (1992; Errata 1993) Refrigeration Piping

ASME B31.9 (1996) Building Services Piping

ASME BPVC SEC I (1995; Addenda 1995 and 1996) Boiler and Pressure Vessel Code: Section I Power Boilers

ASME BPVC SEC II-C (1995; Addenda 1995 and 1996) Boiler and Pressure Vessel Code: Section II Material Part C - Welding Rods, Electrodes, and Filler Metals

ASME BPVC SEC V (1995; Addenda 1995 and 1996) Boiler and Pressure Vessel Code: Section V Nondestructive Examination

ASME BPVC SEC IX (1995; Addenda 1995 and 1996) Boiler and Pressure Vessel Code: Section IX Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A (1992) Recommended Practice

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (1993) Symbols for Welding, Brazing and  
Nondestructive Examination

AWS A3.0 (1994) Welding Terms and Definitions  
Including Terms for Brazing, Soldering  
Thermal Spraying and Thermal Cutting

AWS D1.1/D1.1M (1996) Structural Welding Code - Steel

AWS B2.1 (1980) Qualification of Welding Procedures  
and Welders for Piping and Tubing

AWS QC1 (1988) AWS Certification of Welding  
Inspectors

AWS Z49.1 (1994) Safety in Welding, Cutting and  
Allied Processes

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1926 Safety and Health Regulations for  
Construction

1.2 RELATED REQUIREMENTS

Section 15050N, "Basic Mechanical Materials and Methods" applies to this section with the additions and modifications specified herein.

1.3 DEFINITIONS

AWS A3.0 and applicable ANSI piping documents.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Welding pressure piping

SD-07 Certificates

Welding procedures qualification

Nondestructive examination (NDE) procedures

NDE personnel certification procedures

Inspector certification

Submit inspector certification and NDE personnel certification for record.

SD-11 Closeout Submittals

Weld identifications

## 1.5 QUALITY ASSURANCE

### 1.5.1 Welding Pressure Piping

Show location, length, and type of welds, and indicate postweld heat treatment and nondestructive testing as required.

### 1.5.2 Procedures

Develop and qualify procedures for welding metals included in the work. Do not start welding until welding procedures, welders, and welding operators have been qualified. Perform qualification testing by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer in accordance with the qualified procedures. Notify the Contracting Officer at least 24 hours in advance of the time and place of the tests. When practicable, perform the qualification tests at or near the work site. Maintain current records of the test results obtained in welding procedure, welding operator/welder performance qualifications, and nondestructive examination (NDE) procedures. These records shall be readily available at the site for examination by the Contracting Officer. Qualify the procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses. ANSI Piping requirements for branch connections may be used in lieu of detailed designs. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor.

#### 1.5.2.1 Previous Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for the work without requalification provided that the following conditions are fulfilled:

- a. Copies of welding procedures, procedure qualification test records, and welder and welding operator performance qualification test records are submitted and approved in accordance with the paragraph entitled "Submittals."
- b. Testing was performed by an approved testing laboratory or technical consultant or by the Contractor's approved quality control organization.
- c. The welding procedures, welders, and welding operators were



qualified in accordance with ASME BPVC SEC IX or AWS B2.1, AR-2 level; and base materials, filler materials, electrodes, equipment, and processes conformed to the applicable requirements of this specification.

- d. The requirements of paragraph entitled "Welder and Welding Operator Performance Qualification" for renewal of qualification were met, and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

#### 1.5.2.2 Performance

The Contractor shall be responsible for the quality of joint preparation, welding, and examination. Clearly identify and record materials used in the welding operations. The examination and testing defined in this specification are minimum requirements. Provide additional examination and testing as necessary to achieve the quality required.

#### 1.5.3 Welding Procedures Qualification

Qualification of the welding procedures for each group of materials to be welded is required as indicated in ASME BPVC SEC IX. Record in detail and qualify the "Welding Procedure Specifications" for every welding procedure proposed. Qualification for each welding procedure shall conform to the requirements of ANSI Standards and to this specification. The welding procedures shall specify end preparation for welds, including cleaning, alignments, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required by ANSI Piping documents, unless otherwise indicated or specified. Describe the type of backing rings or consumable inserts, if used, and, if they are to be removed, the removal process. Welding procedure qualifications shall be identified individually and referenced on the shop drawings or suitably keyed to the contract drawings.

#### 1.5.4 Welder and Welding Operator Performance Qualification

Qualify each welder and welding operator assigned to work covered by this specification by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires from the same specification, classification, or group number that will be encountered on his assignment. Welders or welding operators who make acceptable procedure qualification tests will be considered performance-qualified for the welding procedure used. Determine performance qualification in accordance with ASME BPVC SEC IX, ANSI Piping Standards and as specified.

#### 1.5.5 Renewal of Qualification

Requalification of a welder or welding operator shall be required under one or any combination of the following conditions:

- a. When a welder or welding operator has not used the specific welding process for a period of 3 months. The period may be extended to 6 months if the welder has been employed on another

welding process.

- b. There is specific reason to question the welder's ability to make welds that will meet the requirements of the specifications.
- c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract and a qualification test has not been taken within the preceding 12 months. Renewal of qualification under this condition need be made on only a single test joint or pipe of any thickness, position, or material to reestablish qualification for any thickness, position, or material for which the welder or welding operator had qualified previously.

#### 1.5.6 Qualification of Inspection and (NDE) Personnel

Qualification of Inspection and Nondestructive Examination (NDE) Personnel: Qualify inspection and nondestructive examination personnel in accordance with the following requirements:

##### 1.5.6.1 Inspector Certification

Qualify welding inspectors in accordance with AWS QC1.

##### 1.5.6.2 NDE Personnel Certification Procedures

Certify NDE personnel and establish a written procedure for the control and administration of NDE personnel training, examination, and certification. Base procedures on appropriate specific and general guidelines of training and experience recommended by ASNT RP SNT-TC-1A, Supplement A-Radiographic, Supplement B-Magnetic particle, Supplement C-Ultrasonic, and Supplement D-Liquid Penetrant.

##### 1.5.6.3 Welding Procedures and Qualifications

- a. Specifications and Test Results: Submit copies of the welding procedure specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds. Submit this information on the forms printed in ASME BPVC SEC IX or their equivalent.
- b. Certification: Before assigning welders or welding operators to the work, submit their names, together with certification that each individual is performance qualified as specified. Do not start welding work prior to procedure qualification. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

##### 1.5.7 Symbols

Conform to AWS A2.4.

#### 1.5.7.1 Weld Identifications

Submit a list of the welders' names and symbol for each welder. To identify welds, submit written records indicating the location of welds made by each welder or welding operator.

#### 1.5.8 Safety

Conform to AWS Z49.1, 29 CFR 1910-SUBPART Q, "Welding, Cutting, and Brazing," 29 CFR 1926-SUBPART J, "Welding and Cutting."

#### 1.6 ENVIRONMENTAL

Do not perform welding when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Contracting Officer will determine when weather or working conditions are unsuitable for welding.

#### 1.7 DELIVERY AND STORAGE

Deliver filler metals, electrodes, fluxes and other welding materials to the site in manufacturers' original packages and store in a dry space until used. Label and design packages properly to give maximum protection from moisture and to assure safe handling.

### PART 2 PRODUCTS

#### 2.1 WELDING MATERIALS

Comply with ASME BPVC SEC II-C. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

### PART 3 EXECUTION

#### 3.1 WELDING

Do not deviate from applicable codes, approved procedures and approved shop drawings without prior written approval from the Contracting Officer. Materials or components with welds made off the site will not be accepted if the welding does not conform to the requirements of this specification unless otherwise specified. Assign each welder or welding operator an identifying number, letter, or symbol that shall be used to identify his welds. Each welder or welding operator shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, place identification marks adjacent to the welds at 3 foot intervals. Confine identification by die stamps or electric etchers to the weld reinforcing crown, preferably in the finished crater.

### 3.2 WELDING OPERATORS

Perform welding in accordance with qualified procedures using qualified welders and welding operators.

### 3.3 SUPPORTS

Welding of hangers, supports, and plates to structural members shall conform to AWS D1.1/D1.1M.

### 3.4 EXAMINATIONS AND TESTS

Visual and nondestructive examinations shall be performed by the Government and by the Contractor to detect surface and internal discontinuities in completed welds. Employ the services of a qualified commercial inspection or testing laboratory or technical consultant approved by the Contracting Officer. Visually examine welds Radiographic, Liquid penetrant, Magnetic particle, or Ultrasonic examination shall be required as indicated in Tables IV and V attached to this section or in accordance with other sections where detailed requirements are specified. Random NDE testing applies to ASME B31.3 and ASME B31.4 piping unless specified otherwise. When examination and testing indicates defects in a weld joint, a qualified welder shall repair the weld in accordance with the paragraph entitled "Corrections and Repairs" of this section.

#### 3.4.1 Random NDE Testing

When radiographic, liquid penetrant, magnetic particle, or ultrasonic examination is required, test a minimum of 10 percent of the total length or number of piping welds. Randomly select the welds examined, but include an examination of welds made by each welding operator or welder. If random testing reveals that a weld fails to meet minimum quality requirements, examine an additional 10 percent of the welds in that same group. If the additional welds examined meet the quality requirements, the entire group of welds represented shall be accepted and the defective welds shall be repaired. If any of the additional welds examined also fail to meet the quality requirements, that entire group of welds shall be rejected. Remove and reweld rejected welds or examine rejected welds 100 percent and remove and reweld defects.

#### 3.4.2 Visual Examination

Visually examine welds as follows:

- a. Before welding -- for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.
- b. During welding -- for conformance to the qualified welding procedure.
- c. After welding -- for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

### 3.4.3 Nondestructive Examination

NDE shall be in accordance with written procedures. Procedures for radiographic, liquid penetrant, magnetic particle, or ultrasonic tests and methods shall conform to ASME BPVC SEC V. The approved procedure shall be demonstrated to the satisfaction of the Contracting Officer's QA personnel.

In addition to the information required in ASME BPVC SEC V, the written procedures shall include:

- a. Timing of the nondestructive examination in relation to the welding operations.
- b. Safety precautions.

### 3.4.4 Examinations and Tests by the Government

Examinations and tests will conform to paragraphs "Visual Examination" and "Nondestructive Examination" of this section, except that destructive tests may be required also. When destructive tests are made, qualified welders or welding operators shall make repairs using welding procedures which will develop the full strength of the members cut. Welding shall be subject to examination and tests in the mill, shop, and field.

### 3.4.5 Piping Subject to 100 Percent NDE

ASME B31.4 and ASME B31.3 Piping Subject to 100 Percent NDE: 100 percent of each day's girth welds installed in the following locations shall be nondestructively examined 100 percent by radiographic, magnetic particle, or liquid penetrant examination unless impracticable, in which case at least 90 percent must be examined. Nondestructive examination must be impracticable for each girth weld not examined.

- a. At onshore locations where a loss of hazardous liquid (petroleum, petroleum products, or anhydrous ammonia) could reasonably be expected to pollute stream, river, lake, reservoir, or other body of water, and any offshore area;
- b. Within railroad or public road rights-of-way;
- c. At overhead road crossings and within tunnels;
- d. Within the limits of any incorporated subdivision of a State government; and
- e. Within populated areas, including, but not limited to, residential subdivisions, shopping centers, schools, designated commercial areas, industrial facilities, public institutions, and places of public assembly.

## 3.5 ACCEPTANCE STANDARDS

### 3.5.1 Visual

The following indications are unacceptable:

- a. Cracks--external surface.
- b. Undercut on surface which is greater than 1/32 inch deep or 25 percent for ASME B31.3 and 12.5 percent for ASME B31.4 and ASME B31.9 of the wall thickness, whichever is less, provided that the remaining wall thickness is not less than the minimum design thickness. For ASME B31.4 and in accordance with API Std 1104, undercuts over 1/64 inch through 1/32 inch or over 6 to 12.5 percent of the pipe wall thickness, whichever is smaller, shall not exceed 2 inches in a continuous weld length of 12 inches or 1/6 the length of the weld, whichever is smaller; and undercuts 1/64 inch or 6 percent of the wall thickness, whichever is smaller, are acceptable regardless of length.
- c. Weld reinforcement:
  - (1) ASME B31.1, conform to Table I.

TABLE I  
REINFORCEMENT OF GIRTH AND LONGITUDINAL BUTT WELDS

Thickness of Base Metal, inches	Maximum Thickness of Reinforcement for Design Temperature		
	Greater than 750oF	350oF-750oF	Less Than 350oF
	inch	inch	inch
Up to 1/8, incl.	1/16	3/32	3/16
Over 1/8 to 3/16, incl.	1/16	1/8	3/16
Over 3/16 to 1/2, incl.	1/16	5/32	3/16
Over 1/2 to 1, incl.	3/32	3/16	3/16
Over 1 to 2, incl.	1/8	1/4	1/4
Over 2	5/32	The greater of 1/4 in. or 1/8 times the width of the weld in inches.	

NOTES:

1. For double welded butt joints, this limitation on reinforcement given above shall apply separately to both inside and outside surfaces of the joint.
2. For single welded butt joints, the reinforcement limits given above shall apply to the outside surface of the joint only.
3. The thickness of weld reinforcement shall be based on the thickness of the thinner of the materials being joined.
4. The weld reinforcement thicknesses shall be determined from the higher of the abutting surfaces involved.
5. Weld reinforcement may be removed if so desired.

- (2) ASME B31.3, conform to Table II.

TABLE II

Wall Thickness, Inches	Height, Inches
Less than or equal to 1/4	Less than or equal to 1/16
Greater than 1/4, is less than or equal to 1/2	Less than or equal to 1/8
Greater than 1/2, is less than or equal to 1	Less than or equal to 5/32
Greater than 1	Less than or equal to 3/16

## NOTES:

1. Wall thickness is the nominal wall thickness of the thinner of components joined by butt weld.
2. Height: For "Normal Service" and "Severe Cyclic" conditions, use the listed value. For "Category D Fluid Service," use twice the listed value. Measure from surfaces of adjacent components. The lesser of the two measurements, in any plane through the weld, shall not exceed the applicable value at right. Weld metal shall merge smoothly into component surfaces.

(3) ASME B31.4, conform to Table I for under 350 degrees F.

(4) ASME B31.5, conform to Table III.

TABLE III

Pipe Wall Thickness, inches	Reinforcement Thickness, inches
1/4 and under	1/16
Over 1/4 through 1/2	3/32
Over 1/2, through 1	1/8
Over 1	3/16

(5) ASME B31.9: Thickness of weld reinforcement shall not exceed 3/16 inch.

- d. Lack of fusion on surface.
- e. Incomplete penetration (applies only when inside surface is readily accessible).
- f. Convexity of fillet weld surface greater than 10 percent of longest leg plus 0.03 inch.
- g. Concavity in groove welds.
- h. Concavity in fillet welds greater than 1/16 inch.

- i. Fillet weld size less than indicated or greater than  $1 \frac{1}{4}$  times the minimum specified fillet leg length.

### 3.5.2 Magnetic Particle Examination

The following relevant indications are unacceptable:

- a. Any cracks and linear indications.
- b. Rounded indications with dimensions greater than  $\frac{3}{16}$  inch.
- c. Four or more rounded indications in a line separated by  $\frac{1}{16}$  inch or less edge-to-edge.
- d. Ten or more rounded indications in any 6 square inches of surface, with the major dimension of this area not to exceed 6 inches, with the area taken in the most unfavorable location relative to the indications being evaluated.

### 3.5.3 Liquid Penetrant Examination

Indications whose major dimensions are greater than  $\frac{1}{16}$  inch shall be considered relevant. The following relevant indications are unacceptable:

- a. Any cracks or linear indications.
- b. Rounded indications with dimensions greater than  $\frac{3}{16}$  inch.
- c. Four or more rounded indications in a line separated by  $\frac{1}{16}$  inch or less edge-to-edge.
- d. Ten or more rounded indications in any 6 square inches of surface, with the major dimension of this area not to exceed 6 inches, with the area taken in the most unfavorable location relative to the indications being evaluated.

### 3.5.4 Radiography

Welds that are shown by radiography to have any of the following discontinuities are unacceptable:

- a. Any type of crack or zone of incomplete fusion or penetration.
- b. Any other elongated indication which has a length greater than:
  - (1)  $\frac{1}{4}$  inch for  $t$  up to  $\frac{3}{4}$  inch, inclusive;
  - (2)  $\frac{1}{3} t$  for  $t$  from  $\frac{3}{4}$  inch to  $2 \frac{1}{4}$  inches, inclusive;
  - (3)  $\frac{3}{4}$  inch for  $t$  over  $2 \frac{1}{4}$  inches where  $t$  is the thickness of the thinner portion of the weld.

("t" pertains to the thickness of the weld being examined. If a weld joins



two members having different thickness at the weld, "t" is the thinner of these two thicknesses.)

- c. Any group of indications in line that have an aggregate length greater than t in a length of  $12t$ , except where the distance between the successive indications exceeds  $6L$  where L is the longest indication in the group.
- d. Porosity in excess of that shown acceptable in Appendix A-250, Acceptance Standard for Radiographically Determined Rounded Indications in Welds, ASME BPVC SEC I.

### 3.5.5 Ultrasonic Examination

Permitted for ASME B31.3 and ASME B31.4 piping only. Linear type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed the following:

- a.  $1/4$  inch for t up to  $3/4$  inch
- b.  $1/3$  t for t from  $3/4$  inch to  $2\ 1/4$  inches
- c.  $3/4$  inch for t over  $2\ 1/4$  inches

("t" is the thickness of the weld being examined. If the weld joins two members having different thickness at the weld, "t" is the thinner of these two thicknesses. Discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration are unacceptable regardless of length.)

### 3.6 CORRECTIONS AND REPAIRS

Remove defects and replace welds as specified in ANSI Piping Standards, unless otherwise specified. Repair defects discovered between weld passes before additional weld material is deposited. Wherever a defect is removed, and repair by welding is not required, the affected area shall be blended into the surrounding surface eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, reexamine the area by the same test methods which first revealed the defect to ensure that the defect has been eliminated. After rewelding, reexamine the repaired area by the same test methods originally used for that area. For repairs to base material, the minimum examination shall be the same as required for butt welds. Indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no unacceptable indications are present. The use of foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

TABLE IV  
EXAMINATIONS AND TESTS FOR VARIOUS MATERIALS AND SERVICES

Examinations or Tests Required					
Material or Application	Visual	Radiographic	Magnetic Particle or Liquid Penetrant		Ultra-sonic
High-alloy austenitic or nickel steels or nickel alloys for cryogenic service and vacuum service					
a. Tack welds	Yes	No	No	No	
b. Root passes	Yes	No	Yes	No	
c. Intermediate passes	Yes	No	No	No	
d. Completed weld	Yes	100 percent for NPS over 1 1/4 inches 60 percent for NPS 1 1/4 inches and less	Yes(PT only) 1/2 inch and over	Yes for wall thickness	
High-alloy austenitic or nickel steels or nickel alloys for other than cryogenic or vacuum service					
a. Tack welds	Yes	No	No	No	
b. Root passes	Yes	No	No	Yes	No
c. Intermediate passes	Yes	No	No	No	
d. Completed weld	Yes	100 percent Random	Yes(PT only)	No	Yes
Stainless steel to carbon steel					
a. Completed weld	Yes	No Yes Random	Yes(PT only)	No	
Carbon steel piping systems					
a. Tack welds	Yes	No	No		No
b. Root passes	Yes	No	No Yes MT		No
c. Intermediate passes	Yes	No	No		No
d. Completed weld	Yes	100 percent Random	No Yes MT		No

TABLE V  
MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS FOR ASME B31.1 PIPING

	Temperatures over 750 degrees F and at all pressures.	Temperatures between 350 degrees F and 750 degrees F inclusive and at all pressures over 1052 psig gage	All others
Buttwelds (Girth and Longitudinal)	RT for NPS over 2 inches MT or PT for NPS 2 inches and less.	RT for over 2 inch NPS with thickness over 3/4 inch. Visual for all sizes with thickness 3/4 inch or less.	Visual for all sizes and thicknesses.
Welded Branch Connections (Size indicated is Branch Size)	RT for NPS over 2 inch MT or PT for NPS 2 inch and less.	RT for branch over 4 inch NPS and thickness of branch over 3/4 inch. Visual for all sizes with branch thickness 3/4 inch or less.	Visual for all sizes and thicknesses.
Fillet, Socket Welds	PT or MT for all sizes and thicknesses.	Visual for all sizes and thicknesses.	Visual for all sizes and thicknesses.

## NOTES:

1. Thickness refers to pressure boundary wall thickness (such as pipe wall, fitting wall, or nozzle wall thickness).
2. All welds must be given a visual examination in addition to type of specific nondestructive examination specified.
3. NPS-Nominal Pipe Size.
4. RT-Radiographic examination; MT-magnetic particle examination; PT-liquid penetrant examination.
5. RT of branch welds shall be performed before any nonintegral reinforcing material is applied.
6. The thickness of butt welds is defined as the thicker of the two abutting ends after end preparation.
7. Temperatures and pressures shown are design.
8. In lieu of radiography of welded branch connections when required above, liquid penetrant or magnetic particle examination is acceptable and, when used, shall be performed at the lesser of one-half of the weld thickness or each 1/2 inch of weld thickness and all accessible final weld surfaces.
9. For nondestructive examination of the pressure retaining component, refer to the standards listed in applicable code or the manufacturing specifications.

-- End of Section --

## SECTION 15400A

PLUMBING, GENERAL PURPOSE  
09/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

- |          |   |
|----------|---|
| ARI 1010 | (1994) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers |
| ARI 700  | (1999) Specifications for Fluorocarbon Refrigerants                     |

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |               |   |
|---------------|---|
| ANSI A117.1   | (1998) ICC/ANSI A117.1 (Guidelines for Access Usable Buildings and Facilities)  |
| ANSI Z21.10.1 | (2001) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less                            |
| ANSI Z21.10.3 | (2001) Gas Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous |
| ANSI Z21.22   | (1999; A 2001) Relief Valves for Hot Water Supply Systems   |
| ANSI Z21.56   | (2001) Gas-Fired Pool Heaters   |
| ANSI Z124.1   | (1995) Plastic Bathtub Units  |
| ANSI Z124.3   | (1995) Plastic Lavatories   |
| ANSI Z124.5   | (1997) Plastic Toilet (Water Closet) Seats  |
| ANSI Z124.9   | (1994) Plastic Urinal Fixtures  |
| ANSI Z358.1   | (1998) Emergency Eyewash and Shower Equipment   |

## ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2002) Carbon Steel Forgings for Piping Applications
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 515/A 515M	(2001) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(2001) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 518/A 518M	(1999) Corrosion-Resistant High-Silicon Iron Castings
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 733	(2001) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 74	(1998) Cast Iron Soil Pipe and Fittings
ASTM A 888	(1998e1) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 111	(1998e1) Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
ASTM B 111M	(1998e1) Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock (Metric)
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 152/B 152M	(2000) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 306	(2002) Copper Drainage Tube (DWV)
ASTM B 32	(2000e1) Solder Metal
ASTM B 370	(1998) Copper Sheet and Strip for Building

## Construction

ASTM B 42	(2002) Seamless Copper Pipe, Standard Sizes
ASTM B 43	(1998) Seamless Red Brass Pipe, Standard Sizes
ASTM B 584	(2000) Copper Alloy Sand Castings for General Applications
ASTM B 75	(2002) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 813	(2000e1) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B 828	(2002) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B 88	(2002) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM C 1053	(2000) Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 1004	(1994a) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1248	(2002) Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1785	(1999) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(2001) Rubber Products in Automotive Applications
ASTM D 2235	(2001) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2239	(2001) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

ASTM D 2241	(2000) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2447	(2001) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2002) Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2002) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2485	(1991; R 2000) Evaluating Coatings for High Temperature Service
ASTM D 2564	(2002) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1997) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2661	(2002) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2665	(2002a) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2672	(1996a) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(1998) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	(2001) Polyethylene (PE) Plastic Tubing
ASTM D 2822	(1991; R 1997el) Asphalt Roof Cement
ASTM D 2846/D 2846M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1996; R 2002) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(2001) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe



ASTM D 3035	(2001) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3122	(1995; R 2002) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(2002) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3261	(1997) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(2001) PTFE Resin Skived Tape
ASTM D 3311	(1994) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D 4060	(2001) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 4101	(2002a) Propylene Injection and Extrusion Materials
ASTM D 4551	(1996; R 2001) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane
ASTM D 638	(2002) Tensile Properties of Plastics
ASTM E 1	(2001) ASTM Thermometers
ASTM E 96	(2000e1) Water Vapor Transmission of Materials
ASTM F 1290	(1998a) Electrofusion Joining Polyolefin Pipe and Fittings
ASTM F 1760	(2001) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content

ASTM F 409	(2002) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 437	(1999) Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 438	(2002) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(2002) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441/F 441M	(1999e1) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442/F 442M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F 477	(2002e1) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(1997) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 628	(2001) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
ASTM F 877	(2002a) Crosslinked Polyethylene (PEX) Plastic Hot- and Cold- Water Distribution Systems
ASTM F 891	(2000e1) Coextruded Poly (Vinyl chloride) (PVC) Plastic Pipe with a Cellular Core

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
ENGINEERS (ASHRAE)

ASHRAE 34	(2001; Errata 2002) Designation and Safety Classification of Refrigerants
ASHRAE 90.1	(2001; various Errata) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2002) Atmospheric Type Vacuum Breakers
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ASSE 1002	(1999) Anti-siphon Fill Valves (Ballcocks) for Gravity Water Closet Flush Tanks
ASSE 1003	(2001) Water Pressure Reducing Valves
ASSE 1005	(1999) Water Heater Drain Valves
ASSE 1006	(1986) Residential Use Dishwashers
ASSE 1010	(1996) Water Hammer Arresters
ASSE 1011	(1993) Hose Connection Vacuum Breakers
ASSE 1012	(2002) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1999) Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
ASSE 1018	(2001) Trap Seal Primer Valves, Water Supply Fed
ASSE 1020	(1998) Pressure Vacuum Breaker Assembly
ASSE 1037	(1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

## AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA C203	(2002; A C203a-99) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1999) Disinfecting Water Mains
AWWA C652	(2002) Disinfection of Water-Storage Facilities
AWWA C700	(2002) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(2002) Cold-Water Meters - Turbine Type, for Customer Service
AWWA D100	(1996) Welded Steel Tanks for Water Storage
AWWA EWW	(1998) Standard Methods for the

## Examination of Water and Wastewater

## AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

## ASME INTERNATIONAL (ASME)

ASME A112.1.2	(1991; R 2002) Air Gaps in Plumbing Systems
ASME A112.14.1	(1975; R 1998) Backwater Valves
ASME A112.18.1	(2000) Plumbing Fixture Fittings
ASME A112.19.1M	(1994; R 1999) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1998) Vitreous China Plumbing Fixtures
ASME A112.19.3	(2001) Stainless Steel Fixtures (Designed for Residential Use)
ASME A112.19.4M	(1994; R 1999) Porcelain Enameled Formed Steel Plumbing Fixtures
ASME A112.21.2M	(1983) Roof Drains
ASME A112.36.2M	(1991; R 2002) Cleanouts
ASME A112.6.1M	(1997; R 2002) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2000) Floor and Trench Drains
ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.12	(1998) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(2002) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2002) Wrought Copper and Copper Alloy

## Solder Joint Pressure Fittings

ASME B16.23	(2002) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(2002) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500
ASME B16.29	(2002) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.34	(1996) Valves Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B31.1	(2001) Power Piping
ASME B31.5	(2001) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME CSD-1	(2002) Control and Safety Devices for Automatically Fired Boilers

## CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2000) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(1997) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

## COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015 (1994; R 1995) Copper Tube Handbook

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH  
(FCCCHR)FCCCHR Manual (9th Edition) Manual of Cross-Connection  
Control

## INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 (2003) Accessible and Usable Buildings and  
Facilities

ICC IPC (2000) International Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)MSS SP-110 (1996) Ball Valves Threaded,  
Socket-Welding, Solder Joint, Grooved and  
Flared EndsMSS SP-25 (1998) Standard Marking System for Valves,  
Fittings, Flanges and Unions

MSS SP-44 (1996; R 2001) Steel Pipe Line Flanges

MSS SP-58 (1993) Pipe Hangers and Supports -  
Materials, Design and Manufacture

MSS SP-67 (2002) Butterfly Valves

MSS SP-69 (2002) Pipe Hangers and Supports -  
Selection and ApplicationMSS SP-70 (1998) Cast Iron Gate Valves, Flanged and  
Threaded EndsMSS SP-71 (1997) Gray Iron Swing Check Valves,  
Flanged and Threaded EndsMSS SP-72 (1999) Ball Valves with Flanged or  
Butt-Welding Ends for General ServiceMSS SP-73 (1991; R 1996) Brazing Joints for Copper  
and Copper Alloy Pressure FittingsMSS SP-78 (1998) Cast Iron Plug Valves, Flanged and  
Threaded EndsMSS SP-80 (1997) Bronze Gate, Globe, Angle and Check  
Valves

MSS SP-83 (2001) Class 3000 Steel Pipe Unions  
Socket-Welding and Threaded

MSS SP-85 (1994) Cast Iron Globe & Angle Valves,  
Flanged and Threaded Ends

NACE INTERNATIONAL (NACE)

NACE RP0169 (2002) Control of External Corrosion on  
Underground or Submerged Metallic Piping  
Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1997) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31 (2001) Installation of Oil Burning  
Equipment

NFPA 54 (2002) National Fuel Gas Code

NFPA 90A (2002) Installation of Air Conditioning  
and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 14 (2003) Plastics Piping Components and  
Related Materials

NSF 3 (2001) Commercial Warewashing Equipment

NSF 5 (2000e) Water Heaters, Hot Water Supply  
Boilers, and Heat Recovery Equipment

NSF 61 (2002e) Drinking Water System Components -  
Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01 (1998) Plastic Pipe in Fire Resistive  
Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G 101 (1996) Testing and Rating Procedure for  
Grease Interceptors with Appendix of  
Sizing and Installation Data

PDI WH 201 (1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (1997) Hose Clamp Specifications

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 5 (2000) White Metal Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL 174 (1996; Rev thru Oct 1999) Household  
Electric Storage Tank Water Heaters

UL 430 (1994; Rev thru Mar 2001) Waste Disposers

UL 732 (1995; Rev thru Jan 1999) Oil-Fired  
Storage Tank Water Heaters

UL 749 (1997; Rev thru Mar 2003) Household  
Dishwashers

UL 921 (1996; Rev thru Mar 2000) Commercial  
Electric Dishwashers

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

PL 93-523 (1974; A 1999) Safe Drinking Water Act

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-50012 (Basic) Garbage Disposal Machine,  
Commercial

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 430 Energy Conservation Program for Consumer  
Products

21 CFR 175 Indirect Food Additives: Adhesives and  
Components of Coatings

40 CFR 50.12 National Primary and Secondary Ambient Air  
Quality Standards for Lead

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings



## Plumbing System; G

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

## Electrical Work; G

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

## SD-03 Product Data

## Plumbing Fixture Schedule

Catalog cuts of specified plumbing fixtures, valves, and related piping system and system location where installed.

## Vibration-Absorbing Features; G

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

## Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

## SD-06 Test Reports

## Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

## Test of Backflow Prevention Assemblies; G.

Certification of proper operation shall be as accomplished in

accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

#### SD-07 Certificates

##### Materials and Equipment

Where materials or equipment are specified to comply with requirements of AGA, ASME, or NSF proof of such compliance shall be included. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

##### Bolts

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

#### SD-10 Operation and Maintenance Data

##### Plumbing System; G.

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

### 1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

#### 1.4 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415A ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

#### 1.5 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

#### 1.6 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II.

Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF 61, Section 8.

End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

##### 2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Couplings for Grooved Pipe: Ductile Iron ASTM A 536 (Grade 65-45-12) or Copper ASTM A 536.
- d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- f. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.
- g. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.
- h. Solder Material: Solder metal shall conform to ASTM B 32.
- i. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.
- j. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.
- k. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.
- l. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature 230 degrees F.
- m. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.
- n. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.
- o. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.
- p. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.
- q. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.
- r. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.
- s. Flanged fittings including flanges, bolts, nuts, bolt patterns,

etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

- t. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.

#### 2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrestor: PDI WH 201.
- b. Copper, Sheet and Strip for Building Construction: ASTM B 370.
- c. Asphalt Roof Cement: ASTM D 2822.
- d. Hose Clamps: SAE J1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.
- h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.
- i. Hypochlorites: AWWA B300.
- j. Liquid Chlorine: AWWA B301.
- k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.
- l. Thermometers: ASTM E 1. Mercury shall not be used in thermometers.

#### 2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

#### 2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

## 2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

## Description

## Standard

## 2.3.1 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

## 2.3.2 Thermostatic Mixing Valves

Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

## 2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC IPC. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings.

Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic

material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

#### 2.4.1 Lavatories

Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate.

#### 2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR Manual. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

#### 2.6 DRAINS

##### 2.6.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.6.3.

##### 2.6.1.1 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.



### 2.6.2 Sight Drains

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer and collar	36 square inches
Height of funnel	3-3/4 inches
Diameter of lower portion of funnel	2 inches
Diameter of upper portion of funnel	4 inches

### 2.7 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

### 2.8 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater and booster water heater shall have controls with an

adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume shall be 5 gallons.

#### 2.8.1 Automatic Storage Type

Heaters shall be complete with control system, and shall have ASME rated combination pressure and temperature relief valve.

##### 2.8.1.1 Electric Type

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 4.5 KW. The elements shall be wired so that only one element can operate at a time.

#### 2.9 PUMPS

##### 2.9.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated and shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 4 enclosure. Each pump shall be fitted with a high-grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 3 and 6 inches above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in a NEMA 250, Type 4 enclosure, shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump.

##### 2.9.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended

service. Pump capacities, efficiencies, motor sizes, speeds, and impeller types shall be as shown. Pump and motor shall be supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze. Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover. Pump motors smaller than Fractional horsepower pump motors shall have integral thermal overload protection in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Guards shall shield exposed moving parts.

#### 2.9.3 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A gate valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

##### 3.1.1 Water Pipe, Fittings, and Connections

###### 3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with

operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

#### 3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

#### 3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

#### 3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

#### 3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and full port ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

#### 3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water

pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

#### 3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

#### 3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

##### 3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

##### 3.1.2.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of the pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

## 3.1.2.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

## 3.1.2.4 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

## 3.1.2.5 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

## 3.1.2.6 Copper Tube and Pipe

- a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.
- b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.
- c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.

## 3.1.2.7 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

## 3.1.2.8 Other Joint Methods

## 3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

## 3.1.4 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

## 3.1.4.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for supply, drainage, waste and vent pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified

in Section 07900A JOINT SEALING. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07840 FIRESTOPPING.

#### 3.1.4.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

#### 3.1.4.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.



#### 3.1.4.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

#### 3.1.4.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07900A JOINT SEALING.

#### 3.1.5 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

#### 3.1.6 Supports

##### 3.1.6.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

##### 3.1.6.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT as shown. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05120 STRUCTURAL STEEL.

## 3.1.6.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
  - (1) Be used on insulated pipe less than 4 inches.
  - (2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
  - (3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

- k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
  - (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
  - (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
  - (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.
- m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.
- n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

#### 3.1.6.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

#### 3.1.7 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and

inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

#### 3.1.8 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

### 3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

#### 3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

#### 3.2.2 Heat Traps

Piping to and from each water heater and hot water storage tank shall be

routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

### 3.2.3 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

### 3.2.4 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

## 3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

### 3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

### 3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure.

### 3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 42 inches above floor. Wall-hung service sinks shall be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1.

### 3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

### 3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

#### 3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

#### 3.3.5.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

#### 3.3.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

#### 3.3.5.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

#### 3.3.5.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

#### 3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

#### 3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500A MISCELLANEOUS METAL.

#### 3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

#### 3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

#### 3.3.10 Shower Pans

Before installing shower pan, subfloor shall be free of projections such as nail heads or rough edges of aggregate. Drain shall be a bolt-down, clamping-ring type with weepholes, installed so the lip of the subdrain is flush with subfloor.

## 3.3.10.1 General

The floor of each individual shower, the shower-area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curb or partition, shall be made watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area indicated, in one piece to the maximum extent practicable, allowing a minimum of 6 inches for turnup on walls or partitions, and shall be folded over the curb with an approximate return of 1/4 of curb height. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drains with the drain clamping ring.

## 3.3.10.2 Metal Shower Pans

When a shower pan of required size cannot be furnished in one piece, metal pieces shall be joined with a flatlock seam and soldered or burned. The corners shall be folded, not cut, and the corner seam shall be soldered or burned. Pans, including upstands, shall be coated on all surfaces with one brush coat of asphalt. Asphalt shall be applied evenly at not less than 1 gallon per 50 square feet. A layer of felt covered with building paper shall be placed between shower pans and wood floors. The joining surfaces of metal pan and drain shall be given a brush coat of asphalt after the pan is connected to the drain.

## 3.3.10.3 Nonplasticized Chlorinated Polyethylene Shower Pans

Corners of nonplasticized chlorinated polyethylene shower pans shall be folded against the upstand by making a pig-ear fold. Hot-air gun or heat lamp shall be used in making corner folds. Each pig-ear corner fold shall be nailed or stapled 1/2 inch from the upper edge to hold it in place. Nails shall be galvanized large-head roofing nails. On metal framing or studs, approved duct tape shall be used to secure pig-ear fold and membrane. Where no backing is provided between the studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding 1/2 inch from upper edge. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it will be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Surfaces to be solvent-welded shall be clean. Surfaces to be joined with xylene shall be initially sprayed and vigorously cleaned with a cotton cloth, followed by final coating of xylene and the joining of the surfaces by roller or equivalent means. If ambient or membrane temperatures are below 40 degrees F the membrane and the joint shall be heated prior to application of xylene. Heat may be applied with hot-air gun or heat lamp, taking precautions not to scorch the membrane. Adequate ventilation and wearing of gloves are required when working with xylene. Membrane shall be pressed into position on the drain body, and shall be cut and fit to match so that membrane can be properly clamped and an effective gasket-type seal provided. On wood subflooring, two layers of 15 pound dry felt shall be installed prior to installation of shower pan to ensure a smooth surface for installation.



#### 3.3.10.4 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans

Nonplasticized PVC shall be turned up behind walls or wall surfaces a distance of not less than 6 inches in room areas and 3 inches above curb level in curbed spaces with sufficient material to fold over and fasten to outside face of curb. Corners shall be pig-ear type and folded between pan and studs. Only top 1 inch of upstand shall be nailed to hold in place. Nails shall be galvanized large-head roofing type. Approved duct tape shall be used on metal framing or studs to secure pig-ear fold and membrane. Where no backing is provided between studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding at top inch of upstand. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it is to be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Trim for drain shall be exactly the size of drain opening. Bolt holes shall be pierced to accommodate bolts with a tight fit. Adhesive shall be used between pan and subdrain. Clamping ring shall be bolted firmly. A small amount of gravel or porous materials shall be placed at weepholes so that holes remain clear when setting bed is poured. Membrane shall be solvent welded with PVC solvent cement. Surfaces to be solvent welded shall be clean (free of grease and grime). Sheets shall be laid on a flat surface with an overlap of about 2 inches. Top edge shall be folded back and surface primed with a PVC primer. PVC cement shall be applied and surfaces immediately placed together, while still wet. Joint shall be lightly rolled with a paint roller, then as the joint sets shall be rolled firmly but not so hard as to distort the material. In long lengths, about 2 or 3 feet at a time shall be welded. On wood subflooring, two layers of 15 pound felt shall be installed prior to installation of shower pan to ensure a smooth surface installation.

#### 3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to 10 percent of the lowest equipment rpm.

#### 3.5 IDENTIFICATION SYSTEMS

##### 3.5.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

### 3.5.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09900 PAINTS AND COATINGS.

### 3.5.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated below:

Color	System	Item	Location
_____	_____	_____	_____

### 3.6 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

### 3.7 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTS AND COATINGS.

### 3.8 TESTS, FLUSHING AND DISINFECTION

#### 3.8.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the Contracting Officer for approval.

- a. Drainage and Vent Systems Test. The final test shall include a smoke test.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

##### 3.8.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of
Gauges	

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

##### 3.8.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 1 inch for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

##### 3.8.1.3 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 150 psig and hold this pressure for 2 hours with no drop in pressure.

### 3.8.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

### 3.8.3 System Flushing

#### 3.8.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

#### 3.8.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation. Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 50.12 Part 141.80(c)(1). The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

### 3.8.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.
- j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

#### 3.8.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Except as herein specified, water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied.

The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per

million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

### 3.9 PLUMBING FIXTURE SCHEDULE

#### P-1 WATER CLOSET:

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, floor mounted. Floor flange shall be copper alloy, cast iron, or plastic.

Gasket shall be wax type.

Seat - ANSI Z124.5, Type A, black plastic, elongated, open front.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 1.6 gallons per flush. Automatic flush valves shall be as indicated in paragraph Automatic Flushing System.

#### P-1A WATER CLOSET HANDICAPPED:

Height of top rim of bowl shall be in accordance with ICC A117.1; other features are the same as P-1.

#### P-3 URINAL:

Wall hanging, with integral trap and extended shields, ASME A112.19.2M siphon jet. Top supply connection, back outlet.

Flushometer Valve - Similar to Flushometer Valve for P-1. The maximum water use shall be 1 gallon per flush.

#### P-2 LAVATORY, WALL-HUNG, HANDICAPPED:

Manufacturer's standard sink depth, wall-hung, enameled cast iron ASME A112.19.1M ledge back, mounted at ADA height, with protective insulation on pipes below lavatory.

Faucet - Faucets shall meet the requirements of NSF 61, Section 9. Faucets shall be single control, mixing type. Faucets shall have replaceable seats and washers. Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and handles shall be copper alloy. Connection between valve

and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing pressure of 80 psi.

Handles - Lever type. Cast, formed, or drop forged copper alloy.

Drain - Strainer shall be copper alloy or stainless steel. Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece. See paragraph FIXTURES for optional plastic accessories.

P-2A LAVATORY, COUNTER-TOP, HANDICAPPED:

Same as P-2, except provide a drop-in sink, self-rimming for countertop installation.

P-3 URINAL, HANDICAPPED:

Same as P-2, except mount at ADA height.

P-4 KITCHEN SINK:

Ledge back with holes for faucet and spout. Single bowl 24 x 21 inches stainless steel ASME A112.19.3.

Faucet and Spout - Faucets shall meet the requirements of NSF 61, Section 9. Cast or wrought copper alloy. Aerator shall have internal threads. Flow shall be limited to 0.25 gallon per cycle at a flowing water pressure of 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 2.5 gpm at a flowing water pressure of 80 psi.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

P-5 SERVICE SINK:

Enameled cast iron ASME A112.19.1M, copper alloy or stainless steel ASME A112.19.3 trap standard 24 inches wide x 20 inches deep, splashback 9 inches high, wall mounted 24 inches wide x 20 inches deep, splashback 9 inches high or corner, floor mounted 28 inches square, 6-3/4 inches deep.

Faucet and Spout - Cast or wrought copper alloy, with or without top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Handles shall be lever or four arm type. Strainers shall have internal threads.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers,

couplings, stopper, etc., shall be copper alloy or stainless steel.

Trap - Cast iron, minimum 3 inch diameter.

#### P-6 SHOWER

Shower heads, ASME A112.18.1 other than emergency showers, shall be adjustable spray type and shall include a non-removable, tamperproof device to limit water flow to 2.5 gpm when tested in accordance with ASME A112.18.1.

Cabinet Showers: Free-standing cabinet, single unit with receptor; 34 inches wide by 34 inches deep, fiberglass reinforced plastic with terrazzo or plastic receptor. Cabinet shall include curtain rod, trim, and concealed fittings.

#### P-7 WATER COOLER, DUAL HEIGHT, HANDICAPPED:

High-low water cooler shall meet the requirements of NSF 61, Section 9, shall be self contained, conform to ARI 1010, and use one of the fluorocarbon gases conforming to ARI 700 and ASHRAE 34 which has an Ozone Depletion Potential of less than or equal to 0.05. Shall deliver not less than 8 gph of water at 50 degrees F with an inlet water temperature of 80 degrees F and ambient air temperature of 90 degrees F. Bubbler drinking fountains shall meet the requirements of NSF 61, Section 9. Drinking fountains shall have a self-closing valve with automatic stream regulator, flow control capability, an in-line inlet strainer, and have push-button or bar actuation. Exposed surfaces of stainless steel shall have a satin finish. Waste strainers shall be made of chrome plated brass or stainless steel.

Surface wall-mounted units shall have a bowl and splash back made of stainless steel. The unit shall have concealed fasteners and be for interior installation.

Handicapped units shall be surface wall-mounted. The unit shall clear the floor or ground by at least 8 inches. A clear knee space shall exist between the bottom of the bowl and the floor or ground of at least 27 inches and between the front edge of the bowl and the body of the unit of at least 8 inches. A 8 inch wide clear space shall exist on both sides of the unit. The spout height shall be no more than 36 inches above the floor or ground. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The bowl and splash back shall be made of stainless steel and be for interior installation.

### 3.10 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams.



The framed instructions shall be posted before acceptance testing of the systems.

### 3.11 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in percent per hour based on nominal 90 degrees F delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

#### 3.11.1 Storage Water Heaters

##### 3.11.1.1 Electric

- a. Storage capacity of 120 gallons or less, and input rating of 12 kW or less: minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.
- b. Storage capacity of more than 120 gallons or input rating more than 12 kW: maximum SL shall be 1.9 W/sq. ft. per ASHRAE 90.1, Addenda B.

##### 3.11.1.2 Gas

- a. Storage capacity of 100 gallons or less, and input rating of 75,000 Btu/h or less: minimum EF shall be 0.62-0.0019V per 10 CFR 430.
- b. Storage capacity of more than 100 gallons - or input rating more than 75,000 Btu/h: Et shall be 77 percent; maximum SL shall be  $1.3+38/V$ , per ANSI Z21.10.3.

##### 3.11.1.3 Oil

- a. Storage capacity of 50 gallons or less and input rating of 105,000 Btu/h or less: minimum EF shall be 0.59-0.0019V per 10 CFR 430.
- b. Storage capacity of more than 50 gallons or input rating more than 105,000 Btu/h: EC shall be 83 percent; maximum SL shall be  $1.3+38/V$ , per 10 CFR 430.

## 3.11.2 Unfired Hot Water Storage

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

## 3.11.3 Instantaneous Water Heater

## 3.11.3.1 Gas

Volumes and inputs: ET shall be 80 percent per ANSI Z21.10.3.

## 3.11.3.2 Oil

Capacities and inputs: EC shall be 83 percent per ANSI Z21.10.3.

## 3.11.4 Pool Heaters

Gas/oil fuel, capacities and inputs: ET shall be 78 percent per ANSI Z21.56.

## 3.12 TABLES

TABLE I  
PIPE AND FITTING MATERIALS FOR  
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE					
		A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X	X	X	X	X	
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888. Pipe and fittings shall be marked with the CISPI trademark.		X	X	X	X	
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X	
5	Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A 536 and ASTM A 47/A 47M	X	X		X	X	

TABLE I  
PIPE AND FITTING MATERIALS FOR  
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE					
		A	B	C	D	E	F
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M for use with Item 5	X	X		X	X	
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5	X	X		X	X	
8	Wrought copper grooved joint pressure fittings for non-ferrous pipe ASTM B 75 C12200, ASTM B 152/B 152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X				
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X	
10	Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B	X			X	X	
11	Seamless red brass pipe, ASTM B 43		X	X			
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X	
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X	
14	Seamless copper pipe, ASTM B 42				X		
15	Cast bronze threaded fittings, ASME B16.15				X	X	
16	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X	
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X	

TABLE I  
PIPE AND FITTING MATERIALS FOR  
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE					
		A	B	C	D	E	F
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X	
19	Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D 2661, ASTM F 628	X	X	X	X	X	X
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40) ASTM F 1760	X	X	X	X	X	X
21	Process glass pipe and fittings, ASTM C 1053						X
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518/A 518M		X			X	X
23	Polypropylene (PP) waste pipe and fittings, ASTM D 4101						X
24	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996						X

## SERVICE:

- A - Underground Building Soil, Waste and Storm Drain
- B - Aboveground Soil, Waste, Drain In Buildings
- C - Underground Vent
- D - Aboveground Vent
- E - Interior Rainwater Conductors Aboveground
- F - Corrosive Waste And Vent Above And Belowground
- \* - Hard Temper

TABLE II  
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a	X	X	X	X
	b. Same as "a" but not galvanized for use with Item 4b			X	
2	Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47/A 47M, non-ferrous pipe, ASTM A 536 and ASTM A 47/A 47M,	X	X	X	
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M, for use with Item 2	X	X	X	
4	Steel pipe: a. Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A 53/A 53M, Type S, Grade B			X	
5	Seamless red brass pipe, ASTM B 43	X	X		X
6	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
7	Seamless copper pipe, ASTM B 42	X	X		X
8	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X**	X***
9	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X
10	Wrought copper and bronze solder-joint pressure fittings,	X	X	X	X

TABLE II  
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
	ASME B16.22 for use with Items 5, 7 and 8				
11	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8	X	X	X	X
12	Bronze and sand castings grooved joint pressure fittings for non- ferrous pipe ASTM B 584, for use with Item 2	X	X	X	
13	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D 2447	X			X
14	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D 3035	X			X
15	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D 2239	X			X
16	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 14, 15, and 16	X			X
17	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D 2683 for use with Item 15	X			X
18	Polyethylene (PE) plastic tubing, ASTM D 2737	X			X
19	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846/D 2846M	X	X		X

TABLE II  
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
20	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441/F 441M	X	X		X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F 442/F 442M	X	X		X
22	Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F 437, for use with Items 20, and 21	X	X		X
23	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Items 20, 21, and 22	X	X		X
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Items 20, 21, and 22	X	X		X
25	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785	X			X
26	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241	X			X
27	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466	X			X
28	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467 for use with Items 26 and 27	X			X
29	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464	X			X
30	Joints for IPS pvs pipe using solvent	X			X

TABLE II  
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
	cement, ASTM D 2672				
31	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996	X	X		
32	Steel pipeline flanges, MSS SP-44	X	X		
33	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X		
34	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X	
35	Malleable-iron threaded pipe unions ASME B16.39	X	X		
36	Nipples, pipe threaded ASTM A 733	X	X	X	
37	Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F 877.	X			X

A - Cold Water Service Aboveground

B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground

C - Compressed Air Lubricated

D - Cold Water Service Belowground

Indicated types are minimum wall thicknesses.

\*\* - Type L - Hard

\*\*\* - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors

\*\*\*\* - In or under slab floors only brazed joints



TABLE III  
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING  
EQUIPMENT

## A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS		INPUT RATING	TEST PROCEDURE	REQUIRED
Elect.	120 max.		12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	120 min.	OR	12 kW min.	ASHRAE 90.1 (Addenda B)	SL = 1.9 W/sq. ft. maximum
Gas	100 max.		75,000 Btu/h max.	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	100 min.	OR	75,000 Btu/h	ANSI Z21.10.3	ET = 77 percent; SL = 1.3+38/V max.
Oil	50 max.		105,000 Btu/h	10 CFR 430	EF = 0.59-0.0019V minimum
Oil	51 min.	OR	105,000 Btu/h	10 CFR 430	EC = 83 percent; SL = 1.3+38/V maximum

## B. Unfired Hot Water Storage, instantaneous water heater, and pool heater.

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

## C. Instantaneous Water Heater

Gas	All		All	ANSI Z21.10.3	ET = 80 percent
Oil	All		All	ANSI Z21.10.3	EC = 83 percent

## D. Pool Heater

Gas or Oil	All		All	ANSI Z21.56	ET = 78 percent
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## TERMS:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0  
(trace is permitted).

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in  
percent per hour based on nominal 90 degrees F delta T.

TABLE III  
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING  
EQUIPMENT

## A. STORAGE WATER HEATERS

STORAGE CAPACITY		INPUT	TEST PROCEDURE	REQUIRED
FUEL	GALLONS	RATING		
PERFORMANCE				
HL = Heat loss of tank surface area				
V = Storage volume in gallons				

-- End of Section --

## SECTION 15601N

CENTRAL REFRIGERATION EQUIPMENT FOR AIR CONDITIONING  
08/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 373.04	(1973) Design for Fine-Pitch Wormgearing
AGMA 2005	(1996; Rev. C) Design Manual for Bevel Gears

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S1.13	(1995; R 1999) Methods for the Measurement of Sound Pressure Levels in Air
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## AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 450	(1999) Water-Cooled Refrigerant Condensers, Remote Type
ARI 460	(2000) Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ARI 480	(1995) Refrigerant-Cooled Liquid Coolers, Remote Type
ARI 520	(1997) Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units
ARI 550/590	(1998; Addendum June 1999) Water-Chilling Packages Using the Vapor Compression Cycle;
ARI 560	(2000) Absorption Water Chilling and Water Heating Packages

## AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(2001; Errata 2002) Safety Standard for Refrigeration Systems
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## ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME PTC 23	(1986; R 1997) Atmospheric Water Cooling Equipment (Performance Test Codes)
ASME BPVC SEC VIII	(1998) Boiler and Pressure Vessel Code: Section VIII Pressure Vessels
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

## ASTM INTERNATIONAL (ASTM)

ASTM A 48/A 48M	(2000) Gray Iron Castings
ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001a) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 395/B 395M	(2002) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
ASTM C 67	(2002c) Sampling and Testing Brick and Structural Clay Tile
ASTM D 596	(2001) Reporting Results of Analysis of Water
ASTM D 1654	(1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2996	(2001) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM E 84	(2001) Surface Burning Characteristics of

## Building Materials

## COOLING TECHNOLOGY INSTITUTE (CTI)

CTI ATC-105	(2000) Acceptance Test Code
CTI Std-103	(1994) Redwood Lumber Specifications
CTI Std-112	(1997) Pressure Preservative Treatment of Lumber
CTI Std-114	(1996) Douglas Fir Lumber Specifications (Coast Type)

## U.S. DEPARTMENT OF AGRICULTURE (USDA)

USDA AH 72	Basic Information on Wood as a Material of Construction with Data for its Use in Design and Specification
DOA Bulletin 865	Timber-Connector Joints; Their Strength and Design

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-59223	Cooling Towers, Liquid
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## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2001) Industrial Control and Systems
NEMA ICS 2	(2002) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA MG 1	(1998; Errata 1999) Motors and Generators

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 214	(2000) Water-Cooling Towers
NFPA 255	(2000) Method of Test of Surface Burning Characteristics of Building Materials

## REDWOOD INSPECTION SERVICE (RIS)

RIS Grade Use	(1998) Redwood Lumber Grades and Uses
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## SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec	(1986; Supple No. 1, Aug 1993) Standard
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Specifications for Grades of Southern  
Cypress

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (2000) Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA Grading Rules (1998) Western Lumber Grading Rules

1.2 RELATED REQUIREMENTS

Section 15050N, "Basic Mechanical Materials and Methods," applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Air-cooled condensers, remote-type; G

SD-03 Product Data

Water chillers; G

Electric motors and starters; G

SD-06 Test Reports

Pressure vessel tests; G

Salt-spray tests; G

Make-up water analysis; G

Start-up and initial operational tests; G

Water analysis; G

Field-assembled cooling towers performance tests; G

SD-08 Manufacturer's Instructions

Central refrigeration equipment; G

Chemicals; G

Submit an Occupational Safety and Health Act (OSHA) Material Safety Data Sheet for chemicals provided.

SD-10 Operation and Maintenance Data

Water Chillers, Data Package 3; G

Electric motors and starters, Data Package 3; G

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

#### 1.4 QUALITY ASSURANCE

##### 1.4.1 Modifications of References

In the referenced publications, the advisory provisions shall be mandatory; substitute the word "shall" for "should" or "it is recommended" wherever they appear; reference to the "authority having jurisdiction" and "owner" shall be interpreted to mean the Contracting Officer.

##### 1.4.2 Pressure Vessels

Design, fabrication, inspection, and testing of pressure vessels including waterside and refrigerant side of condensers and liquid coolers (evaporators) shall be in accordance with ASME BPVC SEC VIII and ASHRAE 15.

The ASME official Code U-Symbol or Code UM-Symbol stamped or marked on the vessels, and the submission of the applicable ASME required manufacturer's data report will be accepted as evidence that pressure vessels comply to ASME rules for construction. Submit results of pressure vessel tests. Provide make-up water analysis in accordance with ASTM D 596.

##### 1.4.3 Personnel Protection

Provide personnel protection from moving parts including fans, pulleys, chains, gears, and couplings. High temperature machinery and piping shall be guarded or covered with insulation.

##### 1.4.4 Electrical Systems

Wiring and components shall conform to NFPA 70.

#### 1.5 CENTRAL REFRIGERATION EQUIPMENT

Provide manufacturer's instruction, including evacuation and charging procedures and posted operating instructions for each piece of refrigeration equipment.

#### 1.6 REFRIGERANTS AND OILS

Dehydrate, purge, and charge refrigerant circuit with refrigerant and oil

at factory. Factory oil and refrigerant charge shall be full amount required for operation, if within limits permitted by the Department of Transportation; otherwise, a holding charge shall be furnished. Field charging, where only a holding charge is shipped, shall be accomplished without breaking permanent refrigerant connections. Furnish one complete charge of lubricating oil in sealed containers in addition to that placed in system. Chillers using R-11, R-12, R-113, R-114, R-115, or R-500 as a refrigerant will not be permitted. Refrigerants shall have an Ozone Depletion Factor (ODF) of 0.05 or less. The ODF shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, sponsored by the United Nations Environment Programme.

## PART 2 PRODUCTS

### 2.1 SELF-CONTAINED WATER CHILLERS

Provide complete, packaged water chillers, each mounted on a single welded-steel base. Chillers shall be ready for operation after installation and field testing. Equipment shall operate within capacity range and speed recommended by the manufacturer. Parts weighing 50 pounds or more which must be removed for inspection, cleaning, or repair, such as motors, gear boxes, cylinder heads, casing tops, condenser, and cooler heads, shall have lifting eyes or lugs. Provide insulation for surfaces subject to sweating including the liquid cooler, suction line piping, water boxes, economizer, and cooling lines. Insulation shall conform to Section 15080N, "Mechanical Insulation."

#### 2.1.1 Reciprocating, Helical Rotary, Scroll, Air-Cooled

ARI 550/590. Base capacity and power ratings, at the conditions indicated and specified, on the test requirements of ARI 550/590. Power input shall not exceed 1.14 kW/ton load at full load capacity. For multicompressor units, not less than two independent refrigerant circuits shall be provided. Chillers shall be capable of operating at partial-load conditions without increased vibration over normal vibration at full load operation, and shall be capable of continuous operation down to minimum capacity.

##### 2.1.1.1 Casings

Aluminum not less than 0.040 inch in nominal thickness or steel not lighter than 18 gage ( 0.0516 inch) in nominal thickness. Provide condensers having horizontal air discharge with discharge baffles to direct air upward, constructed of same material and thickness as casing. Provide wire screens or louvers over exposed condenser coil fins not protected by casing.

##### 2.1.1.2 Reciprocating Compressors

Provide with forced-feed lubrication, crankcase heater, hot-gas muffler and suction strainer. Cylinder unloading devices shall be unloaded when compressor starts. Piston speed for open compressors shall not exceed recommendations of manufacturer or 1000 feet per minute (fpm), whichever is less.



#### 2.1.1.3 Helical Rotary Compressors

Positive displacement, oil injected type, and driven by an electric motor. Rotors shall be solid steel, Society of Automotive Engineers Grade 1141 or 1144. Shaft main bearings shall be either sleeve-design type with leaded bronze or steel-backed babbit; or frictionless bearing design, ball or roller type. Housings and covers shall be high-grade cast-iron pressure castings. Lubrication systems shall lubricate rotors, bearings, shaft seal as well as rotor sealing and cooling. Provide an oil safety cutout interlocked with the compressor starter to allow compressor to operate only when oil management system is operational. Provide for lubrication of bearings and shaft seals on shutdown with or without electric power supply.

#### 2.1.1.4 Scroll Compressors

Three-dimensional, compliant, hermetically sealed design. Compressors shall be mounted on vibration isolators. Rotating parts shall be factory balanced. Main bearings shall be rolling-element type. Lubrication systems shall be centrifugal pump type including oil level sight glass and oil charging valve.

#### 2.1.1.5 Condenser Coils

Extended-surface fin-and-tube type. Condenser coils shall be constructed of copper tubes and aluminum fins. Fins shall be hydraulically or mechanically bonded to tubes and installed in a metal casing. Coils shall be circuited and sized for a minimum of 5 degrees F subcooling and full pumpdown capacity.

#### 2.1.1.6 Fans

Statically and dynamically balanced. For V-belt drive fans, provide adjustable sheaves. Provide fans with vibration isolation devices to minimize vibration transmission.

#### 2.1.1.7 Liquid Coolers (Evaporators)

Tubes shall be seamless copper. Refrigerant side design pressure shall comply with ASHRAE 15. Water side design pressure shall not be less than 150 psig. On direct-expansion units, each refrigerant circuit shall be complete with liquid solenoid valve and expansion device capable of modulating to minimum capacity. For the water side of liquid cooler, the performance shall be based on a water velocity ranging from 3 to 12 fps with a fouling factor of 0.00025. Cooler shall be provided with an electrical heating cable for freeze-up protection to 0 degrees F ambient.

#### 2.1.1.8 Controls, Control Panels, and Gages

Provide a control panel fitted with a discharge pressure gage, suction pressure gage, separate high pressure cutout with manual reset, separate low pressure cutout, low water temperature cutout with manual reset, compressor operating control, and manual off-auto switch. Provide oil pressure gage and low-oil-pressure cutout switch with manual reset for chillers with positive displacement type oil pumps. Provide signal lights

or other visual "failed" indications for high pressure, low pressure, and oil pressure protection devices. Multicompressor units shall be provided with a lead/lag selector switch. Provide a timer to prevent compressors from short cycling whenever stopped by safety controls. Time delay shall be not less than 5 minutes. A pumpdown cycle of the nonrecycling start type shall be provided for each compressor 20 tons or larger. Provide a minimum 4 inch alarm bell and alarm bell circuit to actuate bell in event of machine cutout on protective devices, except when low-pressure cutout is used as an operating control. Provide system capacity control to adjust chiller output to a minimum of 10 percent of full load capacity without cycling operating compressor and to automatically recycle system on power interruption. Provide start-up and head pressure controls to allow for system operation at all ambient temperatures down to 30 degrees F.

#### 2.1.1.9 Electric Motors and Starters

Provide induction electrical motors conforming to NEMA MG 1. Fan motor bearings shall be permanently lubricated. Compressor starters shall be reduced-voltage type conforming with NEMA ICS 1 and NEMA ICS 2. Provide phase failure, over voltage and low voltage protection.

### 2.2 FINISHES

Steel surfaces of equipment including reciprocating, helical rotary, scroll, air cooled water chillers, and air-cooled, remote-type condensers, that do not have a zinc coating conforming to ASTM A 123/A 123M, or a duplex coating of zinc and paint, shall be provided with a factory applied coating or paint system. Thickness of coating or paint system on the actual equipment shall be identical to that on the salt-spray test specimens with respect to materials, conditions of application, and dry film thickness.

### 2.3 SOURCE QUALITY CONTROL

#### 2.3.1 Salt-Spray Tests

Factory-applied coating or paint system on equipment located outdoors including reciprocating, helical rotary, scroll, air-cooled water chillers, and air-cooled remote-type condensers, shall be factory salt-spray tested in accordance with ASTM B 117. Period of test shall be 500 hours. Test specimens shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, coating or paint system shall be evaluated and rated in accordance with procedures A and B of ASTM D 1654. Rating of failure at the scribe mark shall be not less than six (average creepage not greater than 1/8 inch). Rating of the unscribed area shall not be less than 10 (no failure).

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation procedures shall conform to ASHRAE 15, and manufacturer's recommendations. Refrigerant safety relief devices shall have discharge piped to building exterior. Interlock compressor operation with the

chilled water pump starters, so that compressors cannot operate unless the pumps are operating. Make piping connections to equipment after piping systems have been tested and cleaned.

### 3.2 FOUNDATIONS

Foundations for mounting of equipment, accessories, appurtenances, piping, and controls shall be provided, including supports, vibration isolators, stands, guides, anchors, clamps, and brackets. Anchor bolts and sleeves shall be set using templates. Anchor bolts shall be provided with welded-on plates on the head end embedded in the concrete. Equipment bases shall be leveled, using jacks or steel wedges, and grouted in using a nonshrinking type of grouting mortar. Foundations shall conform to manufacturer's recommendations.

### 3.3 LOCATIONS AND CLEARANCES

Equipment shall be located so that working space is available for necessary servicing such as shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide manufacturer's recommended clearances for installation, operation, and maintenance, for cooling towers and chillers located within enclosures.

### 3.4 IDENTIFICATION TAGS AND PLATES

Provide equipment with tags numbered and stamped for their use. Plates and tags shall be brass or nonferrous material. Minimum letter and numeral sizes shall be 1/8 inch high.

### 3.5 FIELD QUALITY CONTROL

Perform tests and provide labor, materials, and equipment required. Notify the Contracting Officer, in writing, 10 days before performing tests. Tests shall be performed in the presence of a manufacturer's representative. Tests shall conform to Section 15950N, "HVAC Testing/Adjusting/Balancing."

#### 3.5.1 Start-Up and Initial Operational Tests

Provide chemicals and place water treatment systems in operation before initial start-up. Equipment shall be started and operated. Follow manufacturer's procedures and place systems under all modes of operation. Initial charges of refrigerant lubricating oil shall be supplemented to ensure maximum operating capacity. Safety and automatic control instruments shall be adjusted. Record manufacturer's recommended readings hourly. Operational tests shall cover a period of not less than 5 days.

#### 3.5.2 Air Temperatures

Take air temperatures by mechanically aspirated psychrometers, and in accordance with ASME PTC 23. Temperatures shall be used as ambient

conditions. When using CTI procedure, temperature measurements shall be in accordance with CTI ATC-105.

#### 3.5.3 Thermometers

Provide to read air and water temperatures simultaneously. Immediately prior to tests, calibrate thermometers by simultaneous immersion in hot well, or other mutually agreed upon method, and note correction factors and points of utilization for each thermometer together with its serial number.

#### 3.5.4 Laboratory Test Results

Submit computations together with six complete sets of test results. Computations and test results shall be presented in full compliance with particular test procedure employed by testing agency.

#### 3.5.5 Manufacturer's Field Services

Furnish manufacturer's representatives who are directly employed by the equipment manufacturers and trained to perform the services specified. The manufacturer's representatives shall furnish advice and services on the following matters:

- a. Erection, alignment, testing and dehydrating;
- b. Testing hermetic equipment under pressure for leaks, and evacuation and dehydration of machine to 35 degrees F wet bulb or an absolute pressure of not over 0.204 inch of mercury;
- c. Charging equipment with refrigerant and oil; and
- d. Starting equipment and training Government personnel on equipment care, operation, and maintenance.

-- End of Section --

## SECTION 15720N

AIR HANDLING UNITS  
**09/99**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1990) Testing Fans for Rating
AMCA 220	(1982) Air Curtain Units
AMCA 300	(1985; R 1987) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(1990) Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D	(1991) Louvers, Dampers and Shutters

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S12.33	(1990) Determination of Sound Power Levels of Noise Sources in a Special Reverberation Test Room
ANSI Z21.47	(1993) Gas-Fired Central Furnaces

## AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1989) Central-Station Air-Handling Units
ARI 440	(1997) Room Fan-Coil and Unit Ventilator
ARI 445	(1987) Room Air-Induction Units
ARI 610	(1996) Central Systems Humidifiers for Residential Applications
ARI 880	(1994) Air Terminals

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING  
ENGINEERS (ASHRAE)

- ASHRAE 52.1 (1992) Air-Cleaning Devices Used in  
General Ventilation for Removing  
Particulate Matter
- ASHRAE 68 (1986) In-Duct Sound Power Measurement  
Procedure for Fans

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM A 123/A 123M (1997; Rev. A) Zinc (Hot-Dip Galvanized)  
Coatings on Iron and Steel Products
- ASTM A 167 (1996) Stainless and Heat-Resisting  
Chromium-Nickel Steel Plate, Sheet, and  
Strip
- ASTM A 653/A 653M (1997) Steel Sheet Zinc-Coated  
(Galvanized) or Zinc-Iron Alloy-Coated  
(Galvannealed) by the Hot-Dip Process
- ASTM B 117 (1997) Operating Salt Spray (Fog) Apparatus
- ASTM D 1654 (1992) Evaluation of Painted or Coated  
Specimens Subjected to Corrosive  
Environments

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

- FS F-F-320 (Rev. B) Filters, Electronic Air Cleaning  
Ionizing Plate Type
- FS F-F-2790 Filter, Air-Extended Area, Initial  
Installation

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA ICS 2 (1993) Industrial Control and Systems  
Controllers, Contactors and Overload  
Relays, Rated Not More Than 2000 Volts AC  
or 750 Volts DC
- NEMA ICS 6 (1993) Industrial Control and Systems  
Enclosures
- NEMA MG 1 (1993; Rev. 1-4) Motors and Generators

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (1999) National Electrical Code
- NFPA 90A (1996) Installation of Air Conditioning

## and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION  
(SMACNA)

SMACNA HVAC Duct Const Stds      (1985) HVAC Duct Construction Standards -  
Metal and Flexible

## UNDERWRITERS LABORATORIES (UL)

UL 507      (1994; R 1997) Electric Fans

UL 586      (1996) High-Efficiency, Particulate, Air  
Filter Units

UL 705      (1994; Bul. 1994, R 1996) Power Ventilators

UL 867      (1995; R 1997) Electrostatic Air Cleaners

UL 883      (1986; R 1989, Errata 1989, Bul. 1994 and  
1996) Fan-Coil Units and Room Fan-Heater  
Units

UL 900      (1994) Air Filter Units

UL 998      (1993; Bul. 1994) Humidifiers

UL 1096      (1986; R 1988, Bul. 1994 and 1996)  
Electric Central Air Heating Equipment

## 1.2 RELATED REQUIREMENTS

Section 15050N, "Basic Mechanical Materials and Methods," applies to this section with the additions and modifications specified herein.

## 1.3 SUBMITTALS

Product data shall include dimensions, weights, capacities, certifications, component performance, electrical characteristics, casing construction details, wiring interconnections, gauges and material finishes. The submittal shall provide all technical information relevant to the product being provided, including but not limited to, all the information shown in the schedules of this specification. It is the responsibility of the supplier to highlight any variances his equipment has with the requirements of this specification whether or not pre-approval has been obtained. Information shall be provided in the same measurement units as indicated elsewhere in this specification. The submittal shall provide fan curves (not fan tables), with specified operating points clearly plotted. The submittal shall provide coil selection worksheets, clearly showing proper consideration for altitude, air density, glycol corrections and indicate coil tube fin and casing construction. The submittal shall provide filter information, including: initial APD, final APD, dust spot efficiency, final dust holding capacity, filter media description, filter frame

details, and filter removal details. The manufacturer shall submit sound power levels for both air handling unit inlet, outlet and radiated at rated capacity. If the unit exceeds sound power levels at scheduled conditions, the manufacturer must provide sound attenuators and meet specified BHP. The manufacturer shall submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring. The manufacturer shall submit the manufacturers recommended installation instructions. Omission of any of the above information will cause shop drawings to be immediately returned without review. Submit the following in accordance with this paragraph and Section 01330, "Submittal Procedures."

## SD-03 Product Data

Central station air handlers

Fans

Fan-coil units

Filter Sections

Eliminators

Drip Pans

Humidifiers

Custom Air Handling Units

Manometers

Include sound rating data and sound power level for all octave-band center frequencies or loudness level.

## SD-06 Test Reports

Corrosion protection

Preliminary tests

Air handling and distribution equipment tests

Dampers leakage test

Include certification by the equipment manufacturer's representative.

## SD-07 Certificates

Central station air handlers

Fans



Fan-coil units

SD-10 Operation and Maintenance Data

Central station air handlers, Data Package 3

Fans, Data Package 3

Fan-coil units, Data Package 3

Custom Air Handling Units Data Package 3

Filter sections, Data Package 2

Humidifiers, Data Package 2

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

#### 1.4 TESTING FOR CORROSION PROTECTION

Comply with ASTM A 123/A 123M, or protect equipment with a corrosion-inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with ASTM B 117. Test 125 hours for equipment installed indoors and 500 hours for equipment installed outdoors or subjected to a marine atmosphere. Each specimen shall have a standard scratch as defined in ASTM D 1654.

##### 1.4.1 Corrosion Criteria

Upon completion of exposure, evaluate coating or painting in accordance with ASTM D 1654. Coat or paint shall show no indication of deterioration, loss of adhesion, or indication of rust or corrosion extending further than 1/8 inch on either side of original scratch.

##### 1.4.2 Thickness of Coating

Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry film thickness.

#### 1.5 QUALITY ASSURANCE

The following shall be used as selection criteria and shall be as specified: airflow rates, external static pressures, water flow rates, electrical requirements. The following are to be equaled or bettered: coil face velocities, filter face velocities, casing leakage rates, casing, base deflection, and energy usage. The following shall be met within 10% of specified values: water pressure drop. Units shall be produced by a recognized manufacturer who maintains a local service agency and parts stock. Air handling units and major components shall be products of manufacturing firms regularly engaged in production of such equipment whose products have been in satisfactory use in similar service for not less than 10 years. Fans shall conform to AMCA bulletins regarding testing and

construction. Coils shall be ARI certified. Filter media shall be ULC listed. Units with factory wiring shall be factory approved and labeled. Failure to comply with this requirement will necessitate the manufacturer, at his expense, to have a certified representative inspect the equipment prior to affixing a label.

#### 1.6 OPERATION AND MAINTENANCE DATA

The manufacturer shall submit operation and maintenance data. The manufacturer shall include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

#### 1.7 ENVIRONMENTAL REQUIREMENTS

Units shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and the fan has been test run under observation, and approved for operation by the Contracting Officer.

### PART 2 PRODUCTS

#### 2.1 FANS

Total sound power level of the fan shall not exceed 90 dBA when tested per AMCA 300 and rated per AMCA 301; statically and dynamically balanced, with air capacities, brake horsepower, fan types, fan arrangement, sound power levels or loudness level, and static pressure as indicated. Fan bearing life shall have a minimum average life of 200,000 hours at design operating conditions. Provide nominal 2 mesh 0.063 inch wire diameter, aluminum or stainless steel bird screens for outdoor inlets and outlets. Equip with automatic (backdraft) dampers where indicated. Have thermal overload protection in the operating disconnect switches within the building. Construct housings and impellers of aluminum or steel, except as specified otherwise. Provide non-sparking construction where indicated. For wiring terminations, provide terminal lugs to match branch circuit conductor quantities, sizes, and materials. Enclose terminal lugs in terminal box sized to NFPA 70.

##### 2.1.1 Centrifugal Fans

AMCA 210 with AMCA seal, forward-curved, backward-inclined or airfoil single width type, direct or V-belt drive motors, and manual or automatic inlet vanes as indicated. Provide bearing cooling fan (heat slinger) and threaded drain connection. Inlet and outlet duct connections shall be flanged. Impeller shall be constructed of steel or aluminum with smooth curved rim, back plate, blades, and cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.

#### 2.2 CENTRAL STATION AIR HANDLERS

ARI 430 with sound rating in accordance with ASHRAE 68, single-type, sound power level, and static pressure, as indicated. Include damper section, supply blower section, filter section with mixing box section or

combination filter-mixing box section, and coil section. Filters, housing coils, and heaters must be completely removable from the unit without having to dismantle the unit or adjacent equipment.

#### 2.2.1 Casings

Construct casings of steel, galvanized steel, or aluminum on channel base and drain pan coated externally with manufacturers standard paint finish. Provide removable panels and access doors for inspection and access to internal parts. Insulate casings with manufacturer's standard materials. For outdoor roof mounted units, provide weatherproof casing in accordance with paragraph entitled "Testing for Corrosion Protection." Finish with seal joints, stationary or adjustable galvanized steel louvers with birdscreen, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500-D.

#### 2.2.2 Dampers

Provide with factory mounted outside and return air dampers in mixing boxes of galvanized steel blades, with vinyl bulb edging and edge seals in galvanized frame, in parallel blade arrangement with non-slip keyed connecting rods and linkages. Permanently secure damper blades on a single shaft with self-lubricating oil impregnated bronze bearings. Position damper blades across short air opening dimension. Maximum leakage is 2 percent at 4 inch water gage differential pressure when sized for 2000 fpm face velocity.

#### 2.2.3 Supply Blower (Fan) Sections

Centrifugal fan of backward-inclined or airfoil blades with V-belt drive motor or V-belt drive motor, adjustable, with belt guards for external mounted motors. Belt guards are not required for internally mounted motors. Bearings shall be grease-lubricated ball-bearing type, with minimum average life of 200,000 hours at design operating conditions.

#### 2.2.4 Vibration Isolation

For the entire fan, motor, and drive assembly, provide 2 inch nominal deflection spring vibration isolators, internally mounted at the factory together with fan discharge flexible connection and thrust restraint springs. As an alternate, vibration isolation may be provided external to air handlers. When alternate is chosen, provide 2 inch nominal deflection springs, pipe and duct flexible connections, thrust restraint springs, and spring type pipe hangers on pipes directly-connected to such air handlers.

#### 2.2.5 Filter Sections

Protect permanent holding frames with rust inhibitor coating. Provide visible identification on media frames showing model number and air-flow direction. Where filter bank is indicated or required, provide means of sealing to prevent bypass of unfiltered air. Except extended media with self-supporting cartridge and high efficiency particulate filters, performance shall be determined in accordance with ASHRAE 52.1. Provide inclined-type manometers for filter stations of 2,000 cfm capacity or more,

including filters furnished as integral parts of air-handling units. Manometers with 1/10 inch graduations and spirit level shall be of sufficient length to read at least 3 inch water gage. Equip with over-pressure safety traps and three-way vent valves.

#### 2.2.5.1 Replaceable Air Filters

UL 900, Class 1, those which, when clean, do not contribute fuel when attacked by flame and emit only negligible amount of smoke, permanent frames with replaceable media, 2 inch nominal thickness, and size as indicated.

#### 2.2.5.2 Disposable Cartridge Air Filters

UL 900, Class 2, UL classified, and factory assembled. Provide filter media of cotton and synthetic fibers having 90 to 95 percent average dust spot efficiencies with maximum final resistance 1.20 inch water gage and maximum face velocity 625 fpm. Construct filter frame of 16 gage sheet steel or aluminum with welded or riveted joints. Calk or gasket entire assembly to prevent air leakage around frames.

#### 2.2.5.3 Filter Housing

Minimum thickness, 14 gage steel with baked finish inside and out. Joints shall be continuously welded. Flange shall have a fixed air sealing gasket with hollow cross section, closed cell rubber or resilient neoprene, suitable for repetitive reuse. Cabinets shall have flanged ends for connection to adjacent ducts. Hinged access doors on both cabinet sides. Provide access doors with fixed air sealing gaskets to be airtight at the static pressure expected in service. Provide two 3/8 inch Society of Automotive Engineers (SAE) flare connection test ports complete with seal cap, one on each side of the filter. Weld test ports into each filter cabinet or plenum. Test port shall not penetrate to filter frame or media.

#### 2.2.6 Mixing Boxes

Include equally sized openings, sized to individually handle full air flow capacity. Provide automatic dampers.

#### 2.2.7 Outside-Air Intake

Provide each roof top unit with a unit-mounted louver, built-in rain lip, and bird screen.

#### 2.2.8 Heating and Cooling Sections

##### 2.2.8.1 Coils

Provide removable coils per ARI 410 with access to both sides. Enclose heating and cooling coils in a common or individual casing with headers and return bends fully contained within casing. Cooling coils shall have drain pans with piping connections to remove condensate. Seal coils to casing to prevent leakage of air around coils.

#### 2.2.8.2 Eliminators

Equip each cooling coil having an air velocity of over 400 fpm through the net face area with moisture eliminators, unless the coil manufacturer guarantees, over the signature of a responsible company official, that no moisture will be carried beyond the drip pans under actual conditions of operation. Construct of minimum 24 gage copper nickel or stainless steel, removable through the nearest access door in the casing or ductwork. Eliminators shall have not less than two bends at 45 degrees and shall be spaced not more than 2 1/2 inches center-to-center on face. Each bend shall have an integrally formed hook as indicated in the SMACNA HVAC Duct Const Stds.

#### 2.2.8.3 Drip Pans

Provide each cooling coil section in both field-and-factory assembled casings with a stainless or galvanized steel drip pan not less than 18 gage with drain connections. Drip pans shall collect, confine, and dispose of all condensate from cooling coils and attachments, including headers, return bends, distributors, and uninsulated pipe and fittings. Where individual eliminator blades are in section (not in one piece from top to bottom of coil bank), provide auxiliary drip troughs at bottom of each section with drains to drip pans. Insulate drip pans with water impervious insulation of sufficient thickness to prevent condensate formation on the exterior at ambient conditions to be encountered.

#### 2.2.9 Humidifiers

Factory-assembled, single or multiple units as required to obtain the capacities indicated.

##### 2.2.9.1 Steam Grid

Units shall inject steam directly into the air stream. Factory mounted in plenum with drain pan for draw-thru units or in diffuser section of blow-thru units.

- a. Electronic Electrode Steam Units: Self-contained, electronic steam generators with steam output as indicated and equipped with disposable tank. Provide each unit with a solid state energy saving control circuit to control steam output and compensate for changing water conditions without chemical additives. Include an integral control and monitoring panel, with a capacity meter, a "change cylinder (container)" indicator, a capacity adjustment control adjusting from 20 to 100 percent of rated output capacity, an on-off drain switch, and an on-auto push button with indicator light. Equip each unit with double-wall insulated steam supply hose, a steam distributor, an automatic fill with cleanable strainers, or an automatic drain valve.

#### 2.3 FAN-COIL UNITS

ARI 440 with UL seal, factory-fabricated. Provide discharge and return-air grilles as indicated, tamperproof front panels, subbases, replaceable

filters, unit levelers, grease or oil-lubricated motor bearings with minimum average life of 200,000 hours at the design operating conditions, and vibration isolators. Conform with requirements below.

2.3.1 Coils

Single and water.

2.3.2 Style

Vertical or Horizontal, as indicated.

2.3.3 Controls

Pneumatic or Electric type as indicated.

2.3.3.1 Fans

Automatic with selected speed-to-off, high-to-low on cooling and low-to-off on heating fan-cycled type. Construct fan wheels and scrolls of galvanized steel.

2.3.3.2 Valves

Three-way automatic modulating valves. Valves shall be unit-mounted.

2.3.3.3 Summer-Winter Switches

Automatic.

2.3.3.4 Air Dampers

Automatic dampers.

2.3.4 Unit Enclosures

Exposed, Recessed, Semi-recessed, or suitable for duct connections as indicated.

2.3.5 Mounting

Floor (free standing), Ceiling or Wall-mounted.

2.3.6 Sound Power Level (Reference; 10 to the Power of -12 Watts)

ANSI S12.33 maximum 54 dB.

2.4 CUSTOM AIR HANDLING UNITS

The manufacturer shall provide the factory assembled air handling unit in configuration as indicated on the drawings. The unit shall include all specified components installed at the factory. Field fabrication of units and their components will not be accepted. The unit shall be designed to be supported by a concrete pad, on-grade. Units shall be shipped to the

site in sections.

#### 2.4.1 Casing

Walls and roofs shall be constructed of 16 gauge satin coat galvanized steel 4 in thick acoustic thermal panels. The inner liner shall be 22 gauge perforated galvanized steel. Insulation shall be 4 in thick 3 lbs/cubic ft. rigid coated insulation. All permanently joined flanged panel surfaces shall be sealed with an individual strip of 0.12 in x 0.38 in tape sealer. Wall seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit. Outdoor units shall have roof panels broken outward to provide a lapped joint watertight seal. Outdoor roofs shall be sloped a minimum of 0.62 in away from the access side. All panels shall be joined on 8 in centers using cadmium plated TEK screws. All insulation edges shall be protected with metal lagging. Insulation systems using stickpins or adhesives are not acceptable. Stiffeners of angle steel shall be supplied as required to maintain casing deflection criteria of 1/200 at 1.5 times the working pressure. If panels cannot meet this deflection, an additional internal reinforcing shall be added.

Acoustical Performance: The housing shall have been tested for acoustical performance by an accredited independent laboratory. Test methods and facilities used to establish sound transmission loss values shall conform explicitly with the ASTM designation E90-85 and E413-73.

Sound Transmission Loss DB ASTM E-90 & E413-73

	1	2	3	4	5	6	7	8	
2 in Walls			18	19	27	33	43	52	52 52 52 STC=37
4 in Walls			20	20	28	41	51	56	55 57 STC=40

Test methods and facilities used to establish sound absorption values shall conform explicitly with the requirements of the ASTM Standard Test Method for Sound Absorption Coefficients by the Reverberation Method: ASTM C423-84A and E795-83

Sound Absorption ASTM C423-84A & E795-83

	1	2	3	4	5	6	7	8	
2 in Walls			.10	.23	.75	1.08	1.05	.99	.97 .95 STC=37
4 in Walls			.40	.65	1.38	1.28	1.09	1.05	1.02 1.02 STC=40

The manufacturer shall submit the lab report for approval.

#### 2.4.2 Base Construction

Units shall be constructed from structural steel C-channel around the perimeter of the unit with intermediate channel and angle iron supports. Units less than or equal to 20 ft in length shall have a minimum 4 in channel, and units greater than 20 ft in length shall have a minimum 6 in channel. A 0.125 in checker plate checker plate floor shall be installed on the base. The floor shall be flat, reinforced from below, with all seams continuously welded. Drive screw attachment and caulking are not

acceptable. The base shall be provided with lifting lugs, a minimum of four (4) per unit section. The base shall be insulated with 4 in R12 Fiberglass insulation and sheeted with a 22 gauge gauge galvanized steel liner. Floors that "oil can" are not acceptable. The manufacturer shall provide a 1.5 in perimeter collar around the entire unit and around each floor opening to ensure the unit is internally watertight. The entire base shall act as an auxiliary drain pan and hold up to 1.5 in of water. The manufacturer shall provide auxiliary drains in fan sections downstream of cooling coils and in mixing sections. All drain connections on floor mounted air handling units shall terminate at the side of the unit. Maximum base deflection shall be 0.25 in on 240 in unsupported span.

#### 2.4.3 Access Doors

Access doors shall be manufactured from 16 gauge . The doors shall be double wall construction with 22 gauge liner on the inside. Corners of the doors shall be continuously welded for rigidity. 2 in 3 lbs/cubic ft density insulation shall be sandwiched between the 16 gauge outer layer and the 22 gauge inner layer. Doors MUST be the same thickness as the unit casing to maximize thermal and acoustical resistance. A 12 in HERMETICALLY SEALED double glazed laminated glass window shall be provided in each door. Hinges shall be continuous piano type stainless steel. Two (2) "Ventlok" Model #310 high pressure latches operable from either side of the door shall be provided. The door opening shall be fully gasketed with continuous 0.5 in closed cell hollow round black gasketing and a metal encapsulated reinforcing backing that mechanically fastens to the door frame. Door frames shall be made from 16 gauge with the outside of the door flush with the unit. The minimum door opening size shall be 18 in x 70 in. Fan compartments must have a door of minimum width to remove the motor. All access doors must swing against the air pressure; i.e., positive pressure plenum doors must swing in.

#### 2.4.4 Non-Scrolled Fans -- Plenum Type

Fans shall be airfoil as indicated in the schedule or the fans shall be centrifugal plenum (plug) type, designed without a scroll type housing. Fans shall incorporate a wheel, heavy gauge reinforced steel inlet plate with removable spun inlet cone, structural steel frame, and shaft and bearings in AMCA Arrangement 3 configuration as an entire assembly. All fan wheels shall have tapered spun wheel cones or shrouds providing stable flow and high rigidity. The wheels shall be non-overloading type. The blades shall be continuously-welded, die-formed Airfoil type, designed for maximum efficiency and quiet operation. Partial welding will not be acceptable on airfoil blades. Impellers shall be statically and dynamically balanced and the complete fan assembly shall be test balanced at the operating speed prior to shipment. Shafts shall be of AISI C-1018, 1040 or 1045 hot rolled steel accurately turned, ground, polished, and ring gauged for accuracy. Shafts shall be sized for first critical speed of at least 1.43 times the maximum speed for the class. Bearings shall be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum class RPM. When specified, the fans shall be supplied with internal or nested type variable inlet vanes for wheel diameter 16.5 in and larger. Cantilevered vane blades



shall be used through Size 490 to minimum air performance insertion losses and noise. The operating mechanism shall be outside the inlet airstream. The manufacturer shall provide OSHA approved fully enclosed metal belt guard sides of galvanized steel and an expanded metal face. The belt guard shall be sized to allow either sheave to be increased by two sizes. The plenum fan assembly shall have an enclosed safety screen as per OSHA Standards. Fans shall have inlet OSHA approved inlet screens.

#### 2.4.5 Vibration Isolation

An integral all welded steel vibration isolation base shall be provided for the fan and motor. Isolators shall be free standing with sound deadening pads and leveling bolts. The spring diameter to compressed operating height ratio shall be 1 to 1. The spring deflection shall be 2 in. Isolators shall have earthquake restraints.

#### 2.4.6 Motors and Drives

Fan motors shall be mounted and isolated on the same integral base as the fan. Fan motors shall be heavy duty, high efficiency open drip-proof, operable at 460 volts, 60 Hz, 3-phase. MOTORS SHALL MEET USA EPACT OF 1992. The v-belt drive shall have a variable pitch sheave for motors less than 7.5 Hp and a constant pitch sheave for motors of 7.5 Hp or greater rated at 1.5 times the motor nameplate.

#### 2.4.7 Coils

Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall be mounted in the unit casing to be accessible for service. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 410. Coils shall be fully enclosed within the casing and cooling coils shall be on mounted 304 stainless steel angle racks manufactured to allow coils to slide out individually. Heating coils shall be mounted on galvanized angle racks manufactured to allow coils to slide out individually. Removable coil access panels shall be provided for removal of coils through the casing wall. "Coils shall be individually removable towards the access side Coils must be individually racked, removable through the side access panels. Coils shall be designed for chilled water, hot water or steam service. All pipe connections shall be on the same unit end, extended through the casing for ease of connection. Water coils handling recently mixed air, or direct outside air, shall be fully drainable by removing a single threaded plug for each coil row. The primary surface shall be round seamless 0.5 in .046 O.D. copper tube on 1 in centers, staggered in the direction of airflow. All joints shall be brazed. The secondary surface shall consist of rippled plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Bare copper tube shall not be visible between fins and the fins shall have no openings or holes which might accumulate lint and dirt. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. The casings shall be constructed of continuous metal. Coil side

plates shall be of reinforced flange type. The coil connection locations shall permit universal mounting of the coil for right or left hand airflow and have equal pressure drop through all circuits. Coils shall be circuited for counterflow heat transfer to provide the maximum mean effective temperature difference for maximum heat transfer rates. Headers on water coils shall be seamless copper tubing. The headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility. The complete 5W coil core shall be tested with 315 lbs air pressure under warm water and be suitable for operation at 250 psi working pressures. Individual tube and core tests before installation of headers is not considered satisfactory. Hydrostatic tests alone will not be acceptable. Water cooling coils shall be circuited for drainability.

#### 2.4.8 Filters

Prefilters shall be 30% efficient prefilters, 90% final filters, pleated and disposable. Each filter shall consist of a non-woven cotton and synthetic fabric media, media support grid and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2. Prefilters shall be installed in a prefabricated channel rack. Prefilters shall be lift-out where access is available upstream of the filter, or slide out when access is not available.

#### 2.4.9 Filter Gauges

The manufacturer shall provide Dwyer 2000 magnehelic gauges. Magnehelic gauges shall be accurate to +/- 2% of full range. One gauge shall be provided for each filter bank. Gauges shall be recessed into the cabinet casing.

#### 2.4.10 Lights

Marine lights with a protective metal cage and glass seals, complete with duplex receptacles, shall be installed on the wall across from the access doors. A switch with an indicator light shall be installed on the unit. Electrical power shall be 120V/1/60.

#### 2.4.11 Finish

The unit shall be finish painted with two components, etch bond primer and alkyd enamel. The color shall be selected by the Owner. All uncoated steel shall be painted with grey enamel. All metal surfaces shall be prepainted with vinyl wash primer to ensure paint bonds to metal. All outdoor units shall be finish coated with polyurethane paint.

#### 2.4.12 Louvers

Louver blades of extruded aluminum construction shall be fixed on a 45 angle and on 4 in centers. Frames shall be of extruded aluminum, minimum 4 in wide. Birdscreen shall be galvanized mesh with 0.5 in x 0.5 in openings and shall be fixed to the rear with cadmium plated screws. The finish shall be natural mill finish.

#### 2.4.13 Unit-Mounted Silencers

Each silencer pod shall consist of radiused noses and tails and perforated metal panels stiffened for flatness. Acoustic media shall be compressed and supported to minimize dusting and erosion. Mineral wool is not acceptable. Insulation shall be encapsulated with Tedlar. The performance and size shall be as per schedule. Silencer pods shall be full height and full width of the plenum. Stacked duct type silencers are not acceptable.

#### 2.4.14 Aluminum Airfoil Dampers

Aluminum airfoil frames and blades shall be a minimum of 12 gauge extruded aluminum. Blades shall be of a single unit airfoil design 6 in wide. Frames shall be extruded aluminum channel with grooved inserts for vinyl seals. Standard frames shall be 2 in x 4 in x 0.62 in on the linkage side, 1 in x 4 in x 1 in on the other 3 sides. Pivot rods shall be 0.88 in hexagon extruded aluminum interlocking into the blade section. Bearings shall be of a double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into the frame to prevent the outer bearing from rotating. The bearing shall be designed so there are no metal-to-metal or metal-to-bearing riding surfaces. The interconnecting linkage shall have a separate Celcon bearing to eliminate friction inside the linkage. Blade linkage hardware shall be installed in a frame outside the airstream. All hardware shall be of non-corrosive, reinforced cadmium plated steel. Damper seals shall be designed for minimum air leakage by means of overlapping seals. Jack shaft assemblies shall be provided for multiple damper installations.

#### 2.4.15 Air Flow Testing

The unit manufacturer shall factory test each unit to ensure it meets the specified air flow requirements. The test shall be carried out in accordance with the guidelines set forth in the SMACNA HVAC AIR TEST MANUAL. An officer of the manufacturing company shall certify test results and forward copies of certified test results to the consultant.

#### 2.4.16 Air Leakage Testing

The unit manufacturer shall factory pressure test each air handling unit to ensure the leakage rate of the casing does not exceed 1.0% of the unit air flow at 1.5 times the rated static pressure. A leakage test shall be performed with VSD and humidifier panels installed. The test shall be conducted in accordance with SMACNA duct construction manual. A calibrated orifice shall be used to measure leakage airflow. An officer of the manufacturing company shall certify test results and forward copies of the certified test results to the consultant. "Double duct" or "side by side" units shall have each duct or side tested independently. Positive pressure plenums shall be tested positively and negative pressure plenums shall be tested negatively.

#### 2.4.17 Sound Testing

Air handling unit sound power levels shall not exceed the levels shown on the schedule. The manufacturer shall furnish sound power levels at the

supply air connection, return air connection, outside air opening, relief air openings and casing radiation for each air handling unit. Test data shall show sound power levels are 10-12 watts for each of eight octave band center frequencies. The manufacturer shall be responsible for providing an independent agency to factory test units. The consultant shall witness the sound test on the units. The manufacturer shall provide transportation for the consultant and owner to the factory.

#### 2.4.18 Flood Testing

All unit bases shall be flooded to a level of 1.5 in after manufacturing to assure there is no leakage through the floor and the perimeter water barrier. The results of the flood test shall be certified by the manufacturer.

#### 2.4.19 Steam Humidifiers

The manufacturer shall mount steam grid provided by the humidifier manufacturer. The balance of steam humidifier components shall be mounted in the field by the contractor. The manufacturer shall provide minimum absorption distance downstream of the humidifier. The manufacturer shall furnish and install, where indicated on the drawings, ULTRA-SORB packaged steam injection type humidifier panel(s) as manufactured by DRI-STEEM. Each ULTRA-SORB panel shall consist of a steam supply header/separator, a condensate collection header and a bank of closely spaced steam dispersion tubes spanning the distance between the two headers. Each tube shall be fitted with two rows of steam discharge tubelets inserted into the tube wall centered on the diametric line and spaced 1.5 in apart. These tubelets shall be made of a non-metallic material designed for steam temperatures. The two rows shall discharge steam in diametrically opposite directions. Each tubelet shall contain a steam orifice sized for its required steam capacity. Each packaged humidifier panel assembly of tubes and headers shall be contained within a galvanized metal casing to allow convenient duct mounting or to facilitate the stacking of and/or the end-to-end mounting of multiple ULTRA-SORB panels in ducts or air handler casing. All tubes and headers shall be of 304 stainless steel and joints shall be heli-arc welded. Tubes shall be jointed to headers with slip fit couplers. The ULTRA-SORB humidifier shall be furnished with the appropriate steam valve, steam strainer and steam traps, when used, all shipped loose for installation on the job.

#### 2.4.20 Drains

The manufacturer shall provide 1 in capped floor drain connections on the side of the unit for complete drainability of the base pan for the following sections:

- Fresh air plenums
- Humidifier sections
- Service corridors
- Fan sections
- Sections upstream and downstream of coils
- All sections if unit has washdown liner

## 2.5 MOTORS AND MOTOR STARTERS

NEMA MG 1, NEMA ICS 2, and NEMA ICS 6, respectively, with electrical characteristics as indicated. Motors shall be totally-enclosed. Motor starters shall be reduced-voltage type with water-resistant enclosure.

## PART 3 EXECUTION

### 3.1 PREPARATION

Provide storage for equipment and materials at the project site. Parts shall be readily accessible for inspection, repair, and renewal. Protect materials and equipment from weather.

### 3.2 INSTALLATION

Install air distribution equipment as indicated and in accordance with the manufacturer's instructions. Provide clearance for inspection, repair, replacement, and service. Electrical work shall conform with NFPA 70 and Division 16, "Electrical." Provide overload protection in the operating disconnect switches and magnetic starters. Locate air intake of air handling equipment at a minimum of 25 feet from industrial stacks, bathroom vents, and sanitary risers. Prevailing wind direction shall not be used as justification for placing air intake closer than 25 feet of exhaust stacks. Locate annunciator panel in maintenance office or foreman's office.

#### 3.2.1 Fans

Install with resilient mountings, flexible electrical leads, and flexible connections between fan inlet and discharge ductwork. Provide sheaves required for final air balance and safety screen where inlet or outlet is exposed.

#### 3.2.2 Air Handling Units

Install assembled units on vibration isolators and isolate fan section with flexible duct connections. Bolt sections together in high pressure units. Pipe drain pan to the nearest floor drain.

The contractor shall pre-insulate the inside of the roof curb prior to installing the unit. Any floor penetrations shall be thoroughly sealed to ensure watertightness and integrity of the entire floor. The contractor shall install units on a level surface which has sufficient strength to support the units. The contractor shall provide components furnished as per manufacturer's literature. The contractor shall provide all water piping so as to ensure that water circuits are serviceable and excessive lengths of pipe need not be dismantled. The contractor shall provide valves in water piping upstream and downstream of each coil to isolate the coils for maintenance and to balance and trim the system. The contractor shall provide drain valves and vent cocks to each coil. The contractor shall provide strainers ahead of all pumps and automatic modulating valves.

The contractor shall provide certified wiring schematics to the electrical division for the equipment and controls. The contractor shall provide all necessary control wiring as recommended by the manufacturer. The

contractor shall provide condensate traps in accordance with the manufacturer's recommendations.

### 3.3 FIELD QUALITY CONTROL

Schedule and administer specified tests. Provide personnel, instruments, and equipment for such tests. Correct defects and repeat the respective inspection and tests. Give the Contracting Officer ample notice of the dates and times scheduled for tests and trial operations. Conduct inspection and testing in the presence of the Contracting Officer.

#### 3.3.1 Inspection

Prior to initial operation, inspect equipment installation for conformance with drawings and specifications.

#### 3.3.2 Preliminary Tests

For each item of air handling and distribution equipment and its components, perform an operational test for a minimum period of 4 hours.

#### 3.3.3 Testing and Balancing

After preliminary tests, perform air handling and distribution equipment tests, adjustment, and balancing in accordance with Section 15950N, "HVAC Testing/Adjusting/Balancing".

-- End of Section --

## SECTION 15810N

DUCTWORK AND DUCTWORK ACCESSORIES  
**08/03**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating
AMCA 501	(1993) Application Manual for Air Louvers

## ASTM INTERNATIONAL (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 653/A 653M	(2002a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 152/B 152M	(2000) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 209	(2002a) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2002e1) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 423	(2002) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 553	(2002) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 1071	(2000) Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM E 90	(2002) Laboratory Measurement of Airborne Sound Transmission Loss of Building

## Partitions and Elements

ASTM E 96	(2000e1) Water Vapor Transmission of Materials
ASTM E 437	(1992; R 1997) Industrial Wire Cloth and Screens (Square Opening Series)

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems
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## SHEET METAL &amp; AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA FGDCS	(1992; Reprint 1998) Fibrous Glass Duct Construction Standards
SMACNA HVAC Duct Const Stds	(1995; Addenda Nov 1997; 6th Printing 2001) HVAC Duct Construction Standards - Metal and Flexible
SMACNA Seismic Restraint Mnl	(1998; Addendum No. 1 Sept 2000) Seismic Restraint Manual Guidelines for Mechanical Systems

## UNDERWRITERS LABORATORIES (UL)

UL 181	(1996; Rev thru Dec 1998) Factory-Made Air Ducts and Air Connectors
UL 555	(1999; Rev thru Jan 2002) Fire Dampers
UL 555S	(1999; Rev thru Jan 2002) Safety for Smoke Dampers
UL 723	(1996; Rev thru Sep 2001) Test for Surface Burning Characteristics of Building Materials

## 1.2 RELATED REQUIREMENTS

Section 15050N, "Basic Mechanical Materials and Methods," applies to this section with the additions and modifications specified herein.

## 1.3 PRESSURE CLASSIFICATION

SMACNA HVAC Duct Const Stds, Section 1, and as indicated.



#### 1.4 Design Requirements

##### 1.4.1 Duct Span Versus Reinforcement Schedule

Submit maximum duct dimension, board stiffness rating, board thickness, type and spacing of reinforcement, and maximum duct static pressure.

##### 1.4.2 Louvered Penthouse

Submit test report for withstanding 125 mph wind force.

##### 1.4.3 Automatic Dampers

Submit certification of damper leakage testing and conformance with AMCA 500-D and specified maximum leakage or pressure drop requirements.

##### 1.4.4 Sound Pressure Level Rating

Submit for inlets and outlets including diffusers, registers and grilles.

##### 1.4.5 Sound Attenuators and Attenuator Ducts Acoustical Tests

Submit certified test data from an independent acoustical testing laboratory, listing sound noise reduction characteristics, static pressure drop, air flow velocity capacity, and insertion loss data.

##### 1.4.6 Plenum or Casing Acoustical Tests

Submit as required in paragraph entitled "Casings and Plenums."

#### 1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-01 Preconstruction Submittals

Diffusers, registers, and grilles

Submit a schedule of inlets and outlets indicating location, catalog model number, manufacturer, dimensional information, sound pressure level rating, nominal rated volumetric flow rate cfm, neck or face velocity at specified cfm, pressure drop at specified cfm, throw and drop for outlets, range for diffusers, and maximum and minimum cfm modulation.

##### SD-02 Shop Drawings

Locations of test holes

SD-03 Product Data

Dampers

Fire dampers

Automatic Smoke-Fire Dampers

Automatic smoke dampers

Sound attenuators

Acoustical duct lining

Flexible ducts and connectors

Insulation and vapor barrier

Duct-liner adhesives

Louvers

Louvered penthouse

Bird screens

Diffusers, registers, and grilles

Troffers

Metal ducts

Test holes

Sound-attenuator ducts

Submit method of closure data for fibrous glass ductwork.

SD-05 Design Data

Duct span versus reinforcement schedule

SD-06 Test Reports

Louvered penthouse

Automatic dampers

Sound pressure level rating

Louvers

Sound attenuators and attenuator ducts acoustical tests

Plenum or casing acoustical tests

Air duct leakage tests

SD-08 Manufacturer's Instructions

Ductwork and ductwork accessories

SD-11 Closeout Submittals

Fibrous glass ducts

Upon completion, and before final acceptance of work, submit a statement signed by a representative of the fibrous glass ductwork manufacturer that installation is in accordance with the specifications and manufacturer's prescribed procedures and techniques.

## 1.6 QUALITY ASSURANCE

### 1.6.1 Qualification of Installer for Fibrous Glass Ductwork

Install ductwork by a firm approved by the fibrous glass ductwork manufacturer. Provide a certified personnel list from the manufacturer, as qualified to fabricate and install the system. Personnel not on the list will not be permitted to fabricate or install the ductwork system.

### 1.6.2 Daily Report for Fibrous Glass Ductwork

Provide a daily written report listing the personnel fabricating and installing the ductwork system. State in the report whether or not the condition and quality of the materials provided were satisfactory in all respects.

### 1.6.3 Modification of References

SMACNA Duct Construction Manuals: The SMACNA recommendations shall be considered as mandatory requirements. Substitute the word "shall" for the word "should" in these manuals.

### 1.6.4 Ductwork and Ductwork Accessories

Submit manufacturer's instruction including job inspection checklist, methods of on-site storage and handling, and recommended repair methods.

## PART 2 PRODUCTS

Provide ductwork systems including ductwork, ductwork hangers and supports, equipment, materials, installation, workmanship, fabrication, assembly, erection, and inspection, shall be in accordance with SMACNA DCS and SMACNA SRM, as modified and supplemented by the contract specifications and drawings.

## 2.1 METAL DUCTS

### 2.1.1 Steel Ducts

ASTM A 653/A 653M galvanized steel sheet, lock-forming quality; coating designation G90.

### 2.1.2 Aluminum Ducts

ASTM B 209 alloy 3003-H14 for aluminum sheet and alloy 6061-T6 or equivalent strength for aluminum connectors and bar stock.

### 2.1.3 Copper Sheets

ASTM B 152/B 152M, light cold rolled temper.

### 2.1.4 Corrosion Resisting (Stainless) Steel Sheets

ASTM A 167.

### 2.1.5 Duct-Liner Adhesives

SMACNA HVAC Duct Const Stds, fire-resistant adhesive.

## 2.2 DUCTS OF PRESSURE CLASSES 3 INCH WATER GAGE OR LESS

Construction, metal gage, hangers and supports, and reinforcements shall conform with SMACNA HVAC Duct Const Stds, except that ducts with pressure classifications below 2 inch water gage that are located outside of the conditioned space shall have a seal class C. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Pressure sensitive tape shall not be used as a primary sealant on ductwork with pressure classifications above one inch water gage. Air leakage shall be less than 5 percent of the system capacity. Construct ductwork of galvanized steel.

### 2.2.1 Curved Elbows

Make a centerline radius not less than 1 1/2 times the width or diameter of the duct.

### 2.2.2 Laps

Make laps at joints in the direction of air flow. Space button-punch or bolt-connection in standing seams at fixed centers not greater than 6 inches.

Longitudinal locks or seams, known as "button-punch snap-lock," may be used in lieu of Pittsburgh Lock, but will not be permitted on aluminum ducts.

### 2.2.3 Fittings

Elbows, vaned elbows, take-offs, branch connections, transitions, splitters, volume dampers, fire dampers, flexible connections, and access doors shall conform with SMACNA HVAC Duct Const Stds, Section 2. Provide factory fabricated airtight, and noncorrosive test holes with screw cap and

gasket.

#### 2.2.4 Acoustical Attenuator Systems

##### 2.2.4.1 Acoustical Duct Lining

Flexible or rigid mineral fiber lining conforming to ASTM C 1071. Lining shall not be less than one inch thick.

##### 2.2.4.2 Net Noise Reduction Values

Conform with the following:

Minimum Net Noise Reduction Values,  
Sound Pressure Level dB  
(Reference Sound Power at 10-12 Watts)

Octave Pass Band	2	3	4	5	6	7
Center-Frequency (Hz)	125	250	500	1000	2000	4000
Noise Reduction (dB)	11	16	19	30	40	32

##### 2.2.4.3 Preformed Duct Liner

Preformed round duct liner designed for insertion in round ducts may be used in the sizes commercially available. Provide duct liner sections with slip-lap joints not less than 2 inches wide. Make joints in accordance with manufacturer's printed instructions. Furnish fire-resistant adhesive to field-coated joints when recommended by the manufacturer to prevent delamination or erosion at joints. Tubular sections of duct liner shall fit the metal duct snugly and without gaps between duct-liner sections.

##### 2.2.4.4 Factory-Fabricated Sound-Attenuator Ducts

Sound-attenuator ducts may be provided in lieu of sound attenuators. Comply with requirements specified herein for sound attenuators. Provide double-walled duct and fitting of an outer zinc-coated metal pressure shell with one inch thick acoustical blanket insulation and an internal perforated zinc-coated metal liner. Install sufficient length of run to obtain the noise reduction value specified. Furnish certification from manufacturer that the sound reduction values specified will be obtained within the length of duct run provided. The internal perforated zinc-coated metal-liner shall be not less than 24 gage, unless ribbed, then not less than 28 gage for the duct liner and not less than 26 gage for the fitting liner with perforations not larger than 3/32 inch diameter. Seal joints as specified in paragraph entitled "Round and Oval Ducts." Rigid molded fiber-glass inserts with the air side surface PVC \_\_\_\_ or neoprene-coated, if complying with all requirements specified herein, may be used in lieu of internal perforated zinc-coated metal liner.

##### 2.2.4.5 Sound Attenuators (Traps)

Provide factory-fabricated attenuators constructed of galvanized steel sheets. Outer casing shall be not less than 22 gage. Acoustical fills shall be mineral fiber conforming to ASTM C 1071. Air flow capacities

shall be as indicated. Pressure drops through attenuators shall not exceed values indicated, or shall be not in excess of 15 percent of the total external static pressure of the air handling system, whichever is less. Acoustically test sound attenuators with metal duct inlet and outlet sections while under rated air flow conditions. Noise reduction data shall include effects of flanking paths and vibration transmission. Attenuators shall be airtight when operating at internal static pressure not less than 2 inches water gage. Conform with noise reduction requirements specified in paragraph entitled "Net Noise Reduction Values."

## 2.3 FLEXIBLE DUCTS AND CONNECTORS

UL 181, Class I, UL listed, SMACNA HVAC Duct Const Stds, and additional requirements herein specified. Provide to connect between rigid ducts and outlets or terminals in ceilings. There shall be no erosion, delamination, loose fibers, or odors from the ducts into the air stream. At 250 degrees F, minimum rating pressures shall be 6 inches water positive and 1/2 inch negative, up to 4,000 fpm and 2 inches water positive and 1/2 inch negative, up to 2500 fpm. Flexible ducts shall be maximum 6 feet in length. Minimum bend radius shall be twice the duct diameter.

### 2.3.1 Materials

Interlocking spiral or helically corrugated type constructed of zinc-coated steel, corrosion-resistant steel, aluminum, or noncollapsible fire-retardant, chloroprene or chlorosulphonated polyethylene impregnated, minimum 30 ounces per square yard woven mineral fabric.

### 2.3.2 Insulation and Vapor Barrier

ASTM C 553 Type 1, Class B-2, minimum one inch nominal thickness and three-quarter lb./cu. ft. density. Sheathe insulation with a vapor barrier having a maximum water vapor permeance of 0.20 perm in accordance with ASTM E 96, Procedure A. Coat ends of insulation with cement to prevent erosion and delamination.

### 2.3.3 Joints

Make airtight slip joints, seal with pressure-sensitive vapor-seal adhesive tape or duct sealer, and secure with sheet metal screws. To prevent insulation compression, place 2 inch wide by one inch thick closed cell foam plastic spacers over joints under vapor barriers. To provide a vaportight joint, provide a zinc-coated steel, corrosion-resistant steel, or aluminum clamp over such spacers.

## 2.4 CASINGS AND PLENUMS

Factory fabricated components with field installation. Furnish certified testing data from plenum or casing manufacturer obtainable directly from an independent acoustical laboratory, listing sound absorption and transmission loss characteristics of panel assembly. Sound absorption coefficients and sound transmission loss, determined by an independent laboratory, shall be in accordance with ASTM C 423 and ASTM E 90 respectively.

## 2.5 DIFFUSERS, REGISTERS, AND GRILLES

### 2.5.1 Material and Finishes

Provide factory-furnished diffusers, registers, and grilles constructed of steel or aluminum. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Steel parts shall be factory zinc phosphate treated prior to priming and painting or have a baked-on enamel finish. Colors shall be selected or approved by Contracting Officer.

### 2.5.2 Sound Pressure Level

Manufacturer certified sound pressure level rating of inlets and outlets. Conform with the following permissible room sound pressure levels:

NC Range, dB

Typical Application

\_\_\_\_\_

\_\_\_\_\_

### 2.5.3 Throw

The distance from the diffuser, register, or grille to the point which the air velocity falls below 50 feet per minute shall not exceed 1.5 times the outlet mounting height.

### 2.5.4 Drop

Maximum drop of air stream shall not be within 5 feet of the floor at the end of the throw.

### 2.5.5 Ceiling Diffusers

Equip with baffles or other devices required to provide proper air distribution pattern as indicated. Provide factory-fabricated, single key, volume dampers. Except for linear diffusers, internal parts shall be removable through the diffuser neck for access to the duct and without the use of special tools.

#### 2.5.5.1 Circular, Square, and Rectangular Diffusers

Construct each ceiling diffuser of four or more concentric elements designed to deliver air in a generally horizontal direction without excess smudging of the ceiling. Interior elements of square and rectangular ceiling diffusers may be circular, square, or rectangular as manufacturer's standard.

### 2.5.6 Registers

Double-deflection supply registers. Provide manufacturer-furnished volume dampers. Volume dampers shall be of the group-operated, opposed-blade type and key adjustable by inserting key through face of register. Operating mechanism shall not project through any part of the register face. Automatic volume control devices will be acceptable. Provide exhaust and

return registers as specified for supply registers, except that exhaust and return registers shall have a single set of nondirectional face bars or vanes having the same appearance as the supply registers.

#### 2.5.7 Grilles

Construct and finish as specified above for registers, except that volume dampers shall be omitted.

### 2.6 DUCT SLEEVES, PREPARED OPENINGS, AND CLOSURE COLLARS

#### 2.6.1 Duct Sleeves

Fabricate from minimum 20 gage galvanized steel or aluminum. Where sleeves are installed in bearing walls, provide structural steel sleeves as indicated. Size sleeves to provide one inch clearance between duct and sleeve or between insulation and sleeve for insulated ducts.

#### 2.6.2 Prepared Openings

Provide one inch clearance between the duct and the sleeve, or one inch clearance between insulation and sleeve for insulated ducts except at grilles, registers, and diffusers.

#### 2.6.3 Packing

ASTM C 553, Type 1, Class B-2, mineral fiber.

#### 2.6.4 Closure Collars

Four inches wide minimum, fabricated from minimum 20 gage galvanized steel or aluminum.

### 2.7 DEFLECTORS

Factory-fabricated and factory- or field-assembled units consisting of curved turning vanes or scoop type extractors for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved vanes for square elbows. For round ducts taking off from rectangular ducts, provide factory fabricated, galvanized sheet metal, spin-in fittings. These fittings shall have scoop extractors, butterfly dampers, and locking quadrant operators.

### 2.8 ACCESS DOORS

Door shall be rigid and airtight with neoprene gaskets and two or more chrome-plated with copper or nickel base galvanized steel hinges and quick fastening locking devices. Provide doors as large as practical. Mount doors, if possible, so that air pressure holds them closed. As an alternative, removable access doors may be used. These access doors shall be constructed from stamped sheet metal and consist of an inner and outer door panel. Where insulated doors are needed, the inner door shall consist of two panels spot-welded together which totally encapsulate fiberglass insulation. The inner and outer doors shall be joined by bolts and



threaded handles in such a configuration that the panels can be drawn together to secure the door to the duct in a sandwich fashion. The handles shall be high impact plastic with threaded metal inserts. Conical springs shall be used between the door panels to facilitate installation and removal of the door. Neoprene gasket shall be used around the outside edge of the inner or outer panel, but not both, to seal the door. This type of door is approved for use on rectangular, round and flat-oval ductwork.

## 2.9 DAMPERS AND LOUVERS

Construct dampers and louvers with galvanized sheet metal two gages heavier than ducts in which installed. Except as modified herein, the construction shall be of aluminum or galvanized steel with interlocking edges and maximum 10 inch blade width. Conform with SMACNA HVAC Duct Const Stds. Dampers shall be opposed-blade type where indicated. Damper blades shall be connected to the damper frame with a non-metallic anti-friction bushing. The blades shall be connected to the frame with a galvanized, zinc coated steel anti-friction bearing pin. The pin shall consist of a single or double row sealed, stainless steel, maintenance free, roller or ball bearing, lubricated for life with a full stroke test of 200,000 or more strokes in accordance with UL 555S. The bearing shall be pressed onto a steel shaft via a knurled stud. A slotted dowel pin is then inserted thru a hole connecting the two pins.

### 2.9.1 Backdraft Dampers (Gravity Dampers or Shutters)

Factory-fabricated, with statically balanced blades that open automatically when the fan starts and close by gravity when the fan stops. Provide the edges of blades with felt or rubber strips to prevent rattling.

### 2.9.2 Manual Volume Dampers

Balancing, factory-fabricated type. Equip dampers with accessible mechanism such as quadrant operators or 3/16 inch rods brought through the side of ducts with locking setscrew and bushing. Where quadrant operators are furnished, provide chrome plated or enamel painted type with exposed edges rounded.

### 2.9.3 Fire Dampers

Provide in accordance with UL 555.

### 2.9.4 Automatic Smoke-Fire Dampers

Multiple blade type, 180 degrees F fusible fire damper link; smoke damper assembly to include pneumatically powered operator. UL 555 as a 1 1/2 hour rated fire damper; further qualified under UL 555S as a leakage rated damper. Leakage rating under UL 555S shall be no higher than Class II at an elevated temperature Category B (250 degrees F for 30 minutes). Pressure drop in the damper open position shall not exceed 0.1 inch w.g. with average duct velocities of 2500 fpm.

## 2.9.5 Automatic Smoke Dampers

UL listed multiple blade type, supplied by smoke damper manufacturer, with pneumatic damper operator as part of assembly. Qualified under UL 555S with a leakage rating no higher than Class II at an elevated temperature category B (250 degrees F for 30 minutes). Pressure drop in the damper open position shall not exceed 0.1 inch w.g. with average duct velocities of 2500 fpm.

## 2.9.6 Automatic Dampers

Section 15901N, "Space Temperature Control Systems." Maximum leakage shall not exceed 10 cfm per square foot of damper face area at 2 inch w.g. pressure difference.

## 2.9.7 Louvers

Fixed type. Fold or bead the edges of louver blades to exclude driving rain. Louvers blades shall be oriented to minimize the entrainment of rainwater. Make louver frames of 16 gage galvanized steel or aluminum. Provide bird (insect) screen constructed of the same type metal as the louvers.

## 2.9.7.1 Bird Screens

ASTM E 437, general industrial-use wire cloth, Grade C, medium light or heavier, nominal 2 mesh 0.063 inch wire diameter, aluminum or galvanized steel bird screens. Provide removable insect screens of grooved type, with vinyl or neoprene spline insert for securing screen cloth.

## 2.10 GASKETED ROUND DUCTWORK, DOUBLE WALL

General: The duct system shall consist of fittings that are factory fitted with a sealing gasket and spiral duct which, when installed according to the manufacturer's instructions, will seal the duct joints without the use of duct sealer. The Contractor may, at his option, convert any or all rectangular ductwork to round, provided that the project space limitations are properly addressed and that the overall system design static pressure not be exceeded.

Materials: Unless otherwise noted, all duct and fittings shall be a minimum of G-60 galvanized steel in accordance with ASTM A-653 and A-924. Perforated liner shall consist of 1/8-inch perforations on 1/4-inch staggered centers corresponding to an overall open area of 23%. Fiberglass insulation shall have a maximum conductivity factor (K) of 0.26 BTU-inch/hour \* ft<sup>2</sup> \* EF at 75EF mean ambient temperature. Retaining fabric shall be 0.008 inch thick, 15.6lb/ft<sup>3</sup> density with an air permeability rate of 9.2 ft<sup>3</sup>/ft<sup>2</sup> \* s.

Construction: Unless otherwise noted, all duct and fittings shall be constructed per SMACNA's Duct Construction Standards (+10 in w.g.) shown in the following table:

Diameter (in inches)	Spiral Duct	Fittings
----------------------	-------------	----------

	Inner	Outer	Inner	Outer
3-12	26	26	24	24
14-24	26	24	24	22
26-34	26	22	24	20
36-50	24	20	22	20
51-58	20	18	22	18

Fittings: All fitting ends shall come factory equipped with a double lipped, U-profile, EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to insure that system will meet all of the performance criteria set forth in the manufacturer's literature. Gasket shall be classified by Underwriter's Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50. All fitting ends shall be calibrated to manufacturer's published dimensional tolerance standard and associated spiral duct. All fitting ends from 5" to 24" diameter shall have rolled over edges for added strength and rigidity. All elbows from 3" to 12" diameter shall be 2-piece die-stamped and continuously stitch welded. All elbows 14" diameter and larger shall be standing sea m gorelock construction and internally sealed.

The radius of all 90-degree and 45-degree elbows shall be 1.5 times the elbow diameter, unless otherwise noted on the contract documents to be 1.0 times the elbow diameter. The radius of all 1.5 degree, 30 degree, and 60 degree elbows shall be 1.0 times the elbow diameter. All fittings that are of either spot welded or button punched construction shall be internally sealed. When contract documents require divided flow fittings, only full body fittings will be accepted. The use of duct taps is unacceptable except for retrofit installations. Damper shall be fitting sized to slip into spiral duct. Damper shall have the following features: Locking quadrant with blade position indicator, two-inch sheet metal insulation stand-off, integral shaft/blade assembly, shaft-mounted, load bearing bushings, and gasketed shaft penetrations to minimize leakage. Double wall duct and fittings shall consist of a perforated or solid inner liner, a 2-inch, 1.50 lb/ft<sup>3</sup> (unless otherwise specified) layer of fiberglass insulation and a solid outer pressure shell. When a perforated inner liner is specified, a retaining fabric shall be wrapped between the perforated inner and the fiberglass insulation. This fabric provides fiber glass tear retention while maintaining the desired acoustical properties. For 1-inch thick insulation, the outer pressure shell diameter shall be 2 inches larger than the inner liner. All fittings shall be furnished with the gasket on the outer shell. The inner shell on all double wall fittings shall extend a minimum of 1" past the outer shell. Double wall to single wall transitions shall be provided where insulated duct connects to non-insulated, single wall duct. Transitions also act as insulation ends reducing the double wall outer shell diameter to the inner shell diameter. When contract documents require divided flow fittings, only full body fittings will be accepted. Double wall saddle taps are unacceptable. All double wall duct and fittings shall be furnished with both an inner liner and an outer pressure shell coupling. The inner liners shall not be fastened together to allow for expansion and contraction. Spiral Duct: Spiral duct shall be calibrated to manufacturer's published dimensional tolerance standard. All spiral duct 12" diameter and larger shall be corrugated for added strength and rigidity. Spiral seam slippage shall be prevented by means of a flat seam and a mechanically formed indentation

evenly spaced along the spiral seam.

Performance: Duct system performance shall meet SMACNA's Leakage Class 33 requirements at the system design static pressure as indicated on the contract documents not to exceed -20 in w.g. or +12 in w.g.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Conform to NFPA 90A, SMACNA HVAC Duct Const Stds. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors, and dampers. Provide electrical isolation between dissimilar metals. Electrical isolation may be fluorinated elastomers or sponge-rubber gaskets. Install ductwork accessories as indicated and as recommended by manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service. Louvers in accordance with AMCA 501.

#### 3.1.1 Ductwork

Air distribution systems shall operate with no chatter or vibration.

##### 3.1.1.1 Field Changes to Ductwork

Those required to suit the sizes of factory-fabricated equipment actually furnished, shall be designed to minimize expansion and contraction. Use gradual transitions in field changes as well as modifications to connecting ducts.

##### 3.1.1.2 Dampers

When installed on ducts to be thermally insulated, equip each damper operator with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Stand-off mounting items shall be integral with the operator or standard accessory of damper manufacturer.

##### 3.1.1.3 Deflectors

Provide in square elbows, duct-mounted supply outlets, take-off or extension collars to supply outlets, and tap-in branch-off connections. Adjust supply outlets to provide air volume and distribution as indicated or specified.

##### 3.1.1.4 Fire Dampers

Install in accordance with manufacturer's instructions for condition of UL 555 and NFPA 90A. Locate as indicated and provide surface penetration sleeves in accordance with approved detail drawings.

## 3.1.1.5 Access Doors

Provide for automatic dampers, volume dampers, fire dampers, coils, thermostats, temperature controllers, valves, filters, humidifiers and other concealed apparatus requiring service and inspection in the duct systems.

## 3.1.1.6 Duct Sleeves, Prepared Openings, and Closure Collars

Provide for ductwork penetrations in floors, walls, and partitions through which metallic ductwork passes.

- a. Duct Sleeves: Fill space between duct and sleeve or between insulation and sleeve for insulated ducts with mineral fiber, except at grilles, registers, and diffusers.
- b. Prepared Openings: Fill space between duct and opening or between insulation and opening for insulated ducts with mineral fiber, except at grilles, registers, and diffusers.
- c. Closure Collars: Fit collars snugly around ducts or insulation. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier. Provide nails with maximum 6 inch centers on collars.

## 3.1.1.7 Packing

Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber.

## 3.1.2 Duct Hangers and Supports

SMACNA HVAC Duct Const Stds, Section 4. Provide seismic restraint complying with SMACNA Seismic Restraint Mnl. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing. Provide retainer clips where C clamps are used.

## 3.1.2.1 Flexible Ducts

Support ducts by hangers every 3 feet, unless supported by ceiling construction. Stretch flexible air ducts to smooth out corrugations and long radius elbows. Provide minimum length to make connections.

## 3.1.2.2 Flexible Connectors

Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc-coated steel clinch-type draw-bands. For rectangular ducts, lock flexible connectors to metal collars.

### 3.1.3 Inspection Plates and Test Holes

Provide, where required, in ductwork or casings for all balance measurements. If possible, test holes should be located at least 7.5 times diameters downstream from a disturbance. Extend cap through insulation.

### 3.1.4 Acoustical Duct Lining

SMACNA HVAC Duct Const Stds, Section 2. Apply lining in cut-to-size pieces attached to interior of ducts with fire-resistant adhesive. Top and bottom pieces shall lap the side pieces. Secure pieces together with welded pins or clips. Do not distort ducts, burn through or mar the finish surface of ducts. Pins and washers shall be flush with the surface of duct liners. Seal breaks and punctures of duct-liner coating with fire-resistant adhesive. Coat exposed edges of the liner at duct ends and other joints where lining will be subject to erosion with a heavy brush coat of fire-resistant adhesive, to prevent delamination of glass fibers.

### 3.1.5 Sound Attenuators

Provide sound attenuators in the discharge duct of each high-pressure fan as indicated. For each system, provide sound attenuators to ensure that the combination of air system equipment and sound attenuation comply with the designed sound levels.

### 3.1.6 Flashing

Section 07600, "Flashing and Sheet Metal." Provide waterproof flashing where ducts pass through exterior walls and roofs.

### 3.1.7 Cleaning of Ducts

Remove all debris and dirt from ducts and wipe clean. Before installing air outlets, force air through entire system at maximum attainable velocity to remove accumulated dust. Provide temporary air filters to protect ductwork which may be harmed by excessive dirt. For large systems, clean duct with high power vacuum machines.

## 3.2 FIELD QUALITY CONTROL

Administer and direct tests. Furnish instruments, equipment, connecting devices, and personnel for the tests. Notify Contracting Officer \_\_\_ days before inspection or testing is scheduled. Correct defects in work. Repeat tests until work is in compliance.

### 3.2.1 Air Duct Leakage Tests

Perform duct air leakage test in accordance with Section 15950N, "HVAC Testing/Adjusting/Balancing."

-- End of Section --

## SECTION 15951A

DIRECT DIGITAL CONTROL FOR HVAC  
12/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500-D (1998) Laboratory Methods of Testing  
Dampers for Rating

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1 (1995) Code for Electricity Metering

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 269 (1996) Seamless and Welded Austenitic  
Stainless Steel Tubing for General Service

ASTM B 88 (1996) Seamless Copper Water Tube

ASTM B 88M (1996) Seamless Copper Water Tube (Metric)

ASTM D 1693 (1997a) Environmental Stress-Cracking of  
Ethylene Plastics

ASTM D 635 (1997) Rate of Burning and/or Extent and  
Time of Burning of Self-Supporting  
Plastics in a Horizontal Position

## ASME INTERNATIONAL (ASME)

ASME B16.34 (199; B16.34a) Valves - Flanged, Threaded,  
and Welding End

ASME B40.1 (1991) Gauges - Pressure Indicating Dial  
Type - Elastic Element

ASME BPVC SEC VIII D1 (1998) Boiler and Pressure Vessel Code;  
Section VIII, Pressure Vessels Division 1  
- Basic Coverage

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/EIA/TIA-232-F (1991) Interface Between Data Technical  
Equipment and Data Circuit-Terminating  
Equipment Employing Serial Binary Data  
Interchange

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in  
Low-Voltage AC Power Circuits

IEEE Std 142 (1991) IEEE Recommended Practice for  
Grounding of Industrial and Commercial  
Power Systems

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA S7.0.01 (1996) Quality Standard for Instrument Air

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1991) Enclosures for Electrical Equipment  
(1000 Volts Maximum)

NEMA ICS 1 (1993) Industrial Control and Systems

NEMA ST 1 (1988) Specialty Transformers (Except  
General-Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 90A (1996) Installation of Air Conditioning  
and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 268A (1998) Smoke Detectors for Duct Application

UL 508 (1993; Rev thru Oct 1997) Industrial  
Control Equipment

UL 555S (1996) Leakage Rated Dampers for Use in  
Smoke Control Systems

UL 94 (1996; Rev thru Jul 1998) Tests for  
Flammability of Plastic Materials for  
Parts in Devices and Appliances

1.2 GENERAL REQUIREMENTS

The direct digital control (DDC) shall be a complete system suitable for



the heating, ventilating and air-conditioning (HVAC) system.

#### 1.2.1 Nameplates, Lens Caps, and Tags

Nameplates and lens caps bearing legends as shown and tags bearing device-unique identifiers as shown shall have engraved or stamped characters. A plastic or metal tag shall be mechanically attached directly to each device or attached by a metal chain or wire. Each airflow measurement station shall have a tag showing flow rate range for signal output range, duct size, and identifier as shown.

#### 1.2.2 Verification of Dimensions

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

#### 1.2.3 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, shall arrange such work accordingly, and shall furnish all work necessary to meet such conditions.

#### 1.2.4 Power-Line Surge Protection

Equipment connected to ac circuits shall be protected from power-line surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

#### 1.2.5 Surge Protection for Transmitter and Control Wiring

DDC system control-panel equipment shall be protected against surges induced on control and transmitter wiring installed outside and as shown. The equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

a. A 10-microsecond by 1,000-microsecond waveform with a peak voltage of 1,500 volts and a peak current of 60 amperes.

b. An eight microsecond by 20-microsecond waveform with a peak voltage of 1,000 volts and a peak current of 500 amperes.

#### 1.2.6 System Overall Reliability Requirement

The system shall be configured and installed to yield a mean time between failure (MTBF) of at least 40,000 hours. Each DDC controller shall be designed, configured, installed and programmed to provide for stand alone operation with minimal performance degradation on failure of other system components to which it is connected or with which it communicates.

## 1.2.7 DDC System Network Accessibility

Where the systems to be controlled by the DDC system are located in multiple mechanical rooms, each mechanical room shall have at least one communication port for the portable workstation/tester. DDC controllers shall be located in the same room as the equipment being controlled or in an adjacent space which has direct access to the equipment room.

## 1.2.8 System Accuracy and Display

The system shall maintain an end-to-end accuracy for one year from sensor to operator's console display for the applications specified and shall display the value as specified. Each temperature shall be displayed and printed to nearest 0.1 degree F.

## 1.2.8.1 Space Temperature

Space temperature with a range of 50 to 85 degrees F plus or minus 0.75 degree F for conditioned space; 30 to 130 degrees F plus or minus 1 degree F for unconditioned space.

## 1.2.8.2 Duct Temperature

Duct temperature with a range of 40 to 140 degrees F plus or minus 2 degrees F.

## 1.2.8.3 Outside Air Temperature

Outside air (OA) temperature with a range of minus 30 to plus 130 degrees F plus or minus 2 degrees F; with a subrange of 30 to 100 degrees F plus or minus 1 degree F.

## 1.2.8.4 Water Temperature

Water temperature with a range of 30 to 100 degrees F plus or minus 0.75 degree F; the range of 100 to 250 degrees F plus or minus 2 degrees F; and water temperatures for the purpose of performing Btu calculations using differential temperatures to plus or minus 0.5 degree F using matched sensors.

## 1.2.8.5 High Temperature

High temperature with a range of 200 to 500 degrees F plus or minus 2.0 degrees F.

## 1.2.8.6 Relative Humidity

Relative humidity, within a range of 20 to 80 percent, plus or minus 6.0 percent of range (display and print to nearest 1.0 percent).

## 1.2.8.7 Pressure

Pressure with a range for the specific application plus or minus 2.0 percent of range (display and print to nearest psi.)

## 1.2.8.8 Flow

Flow with a range for the specific application plus or minus 3.0 percent of range, and flows for the purpose of thermal calculations to plus or minus 2.0 percent of actual flow (display and print to nearest unit, such as gallons per minute).

## 1.2.8.9 KWh and kW Demand

KWh and kW demand with a range for the specific application plus or minus 1.0 percent of reading (display and print to nearest kWh or kW).

## 1.2.8.10 Analog Value Input

An analog value input to the system's equipment via an AI with a maximum error of 0.50 percent of range, not including the sensor or transmitter error. This accuracy shall be maintained over the specified environmental conditions.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

## HVAC Control System; G

Drawings shall be on 34 by 22 inch sheets in the form and arrangement shown. The drawings shall use the same abbreviations, symbols, nomenclature and identifiers shown. Each control system element on a drawing shall have a unique identifier as shown. The HVAC Control System Drawings shall be delivered together as a complete submittal. Deviations must be approved by the Contracting Officer. Drawings shall be submitted along with Submittal SD-01, Data.

## a. HVAC Control System Drawings shall include the following:

Sheet One: Drawing Index, HVAC Control System Legend.

Sheet Two: Valve Schedule, Damper Schedule.

Sheet Three: Compressed Air Station Schematic.

Sheet Four: Control System Schematic and Equipment Schedule.

Sheet Five: Sequence of Operation and Data Terminal Strip Layout.

Sheet Six: Control Loop Wiring Diagrams.

Sheet Seven: Motor Starter and Relay Wiring Diagram.

Sheet Eight: Communication Network and Block Diagram.

Sheet Nine: DDC Panel Installation and Block Diagram.

(Repeat Sheets Four through Seven for each AHU System.)

b. The HVAC Control System Drawing Index shall show the name and number of the building, military site, State or other similar designation, and Country. The Drawing Index shall list HVAC Control System Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. The HVAC Control System Legend shall show generic symbols and the name of devices shown on the HVAC Control System Drawings.

c. The valve schedule shall include each valve's unique identifier, size, flow coefficient Cv, pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure data, dimensions, and access and clearance requirements data. Valve schedules may be submitted in advance but shall be included in the complete submittal.

d. The damper schedule shall contain each damper's and each actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive positioner ranges, locations of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The Damper Schedule shall include the maximum leakage rate at the operating static-pressure differential. The Damper Schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers, access and clearance requirements. Damper schedules may be submitted in advance but shall be included in the complete submittal.

e. The compressed air station schematic diagram shall show all equipment, including: compressor with motor horsepower and voltage; starter; isolators; manual bypasses; tubing sizes; drain piping and drain traps; reducing valves; dryer; and data on manufacturer's names and model numbers, mounting, access, and clearance requirements. Air Compressor and air dryer data shall include calculations of the air consumption of all current-to-pneumatic transducers and of any other control system devices to be connected to the compressed air station, and the compressed air supply dewpoint temperature at 20 psig. Compressed air station schematic drawings shall be submitted for each compressed air station.

f. The HVAC control system schematics shall be in the form shown, and shall show all control and mechanical devices

associated with the HVAC system. A system schematic drawing shall be submitted for each HVAC system.

g. The HVAC control system equipment Schedule shall be in the form shown. All devices shown on the drawings having unique identifiers shall be referenced in the equipment schedule. Information to be included in the equipment schedule shall be the control loop, device unique identifier, device function, setpoint, input range, and additional important parameters (i.e., output range). An equipment schedule shall be submitted for each HVAC system.

h. The HVAC control system sequence of operation shall reflect the language and format of this specification, and shall refer to the devices by their unique identifiers as shown. No operational deviations from specified sequences will be permitted without prior written approval of the Contracting Officer. Sequences of operation shall be submitted for each HVAC control system including each type of terminal unit control system.

i. The HVAC control system wiring diagrams shall be functional wiring diagrams which show the interconnection of conductors and cables to HVAC control panel terminal blocks and to the identified terminals of devices, starters and package equipment. The wiring diagrams shall show necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. Sources of power required for HVAC control systems and for packaged equipment control systems shall be identified back to the panel board circuit breaker number, HVAC system control panel, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown. Wiring diagrams shall be submitted for each HVAC control system.

#### SD-03 Product Data

##### Service Organizations;

Six copies of a list of service organizations qualified to service the HVAC control system. The list shall include the service organization name, address, technical point of contact and telephone number, and contractual point of contact and telephone number.

##### Equipment Compliance Booklet;

The HVAC Control System Equipment Compliance Booklet (ECB) shall be in booklet form and indexed, with numbered tabs separating the information on each device. It shall consist of, but not be limited to, data sheets and catalog cuts which document compliance of all devices and components with the specifications. The ECB shall be indexed in alphabetical order by the unique identifiers. Devices and components which do not have unique identifiers shall

follow the devices and components with unique identifiers and shall be indexed in alphabetical order according to their functional name. The ECB shall include a Bill of Materials for each HVAC Control System. The Bill of Materials shall function as the Table of Contents for the ECB and shall include the device's unique identifier, device function, manufacturer, model/part/catalog number used for ordering, and tab number where the device information is located in the ECB. The ECB shall be submitted along with Submittal SD-04, Drawings.

#### Commissioning Procedures; G

Six copies of the HVAC control system commissioning procedures, in booklet form and indexed, 60 days prior to the scheduled start of commissioning. Commissioning procedures shall be provided for each HVAC control system, and for each type of terminal unit control system. The Commissioning procedures shall reflect the format and language of this specification, and refer to devices by their unique identifiers as shown. The Commissioning procedures shall be specific for each HVAC system, and shall give detailed step-by-step procedures for commissioning of the system.

a. The Commissioning procedures shall include detailed, product specific set-up procedures, configuration procedures, adjustment procedures, and calibration procedures for each device. Where the detailed product specific commissioning procedures are included in manufacturer supplied manuals, reference may be made in the HVAC control system commissioning procedures to the manuals.

b. An HVAC control system commissioning procedures equipment list shall be included that lists the equipment to be used to accomplish commissioning. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

#### Performance Verification Test Procedures;

Six copies of the HVAC Control System Performance Verification Test Procedures, in booklet form and indexed, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation, and other contract documents. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

#### Training;

An outline for the HVAC control system training course with a

proposed time schedule. Approval of the planned training schedule shall be obtained from the Government at least 60 days prior to the start of the training. Six copies of HVAC control system training course material 30 days prior to the scheduled start of the training course. The training course material shall include the operation manual, maintenance and repair manual, and paper copies of overheads used in the course.

#### SD-06 Test Reports

##### Commissioning Report;

Six copies of the HVAC Control System Commissioning Report, in booklet form and indexed, within 30 days after completion of the system commissioning. The commissioning report shall include data collected during the HVAC control system commissioning procedures and shall follow the format of the commissioning procedures. The commissioning report shall include all configuration checksheets with final values listed for all parameters, setpoints, P, I, D setting constants, calibration data for all devices, results of adjustments, and results of testing.

##### Performance Verification Test;

Six copies of the HVAC Control System Performance Verification Test Report, in booklet form and indexed, within 30 days after completion of the test. The HVAC control system performance verification test report shall include data collected during the HVAC control system performance verification test. The original copies of all data gathered during the performance verification test shall be turned over to the Government after Government approval of the test results.

#### SD-07 Certificates

##### Air Storage Tank;

An ASME Air Storage Tank Certificate for each storage tank.

#### SD-10 Operation and Maintenance Data

##### Operation Manual;

##### Maintenance and Repair Manual;

Six copies of the HVAC Control System Operation Manual and HVAC Control System Maintenance and Repair Manual, for each HVAC control system, 30 days before the date scheduled for the training course.

### 1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the

storage condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

#### 1.5 OPERATION MANUAL

An HVAC control system operation manual in indexed booklet form shall be provided for each HVAC control system. The operation manual shall include the HVAC control system sequence of operation, and procedures for the HVAC system start-up, operation and shut-down. The operation manual shall include as-built HVAC control system detail drawings. The operation manual shall include the as-built configuration checksheets, the procedures for changing HVAC control system setpoints, and the procedures for placing HVAC system controllers in the manual control mode.

a. The procedures for changing HVAC control system setpoints shall describe the step-by-step procedures required to change the process variable setpoints, the alarm setpoints, the bias settings, and setpoint reset schedules.

b. The procedures for placing HVAC system controllers in the manual control mode shall describe step-by-step procedures required to obtain manual control of each controlled device and to manually adjust their positions.

#### 1.6 MAINTENANCE AND REPAIR MANUAL

An HVAC control system maintenance and repair manual in indexed booklet form in hardback binders shall be provided for each HVAC control system. The maintenance and repair manual shall include the routine maintenance checklist, a recommended repair methods list, a list of recommended maintenance and repair tools, the qualified service organization list, the as-built commissioning procedures and report, the as-built performance verification test procedures and report, and the as-built equipment data booklet.

a. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all devices listed in the equipment compliance booklet, the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

b. The recommended repair methods list shall be arranged in a columnar format and shall list all devices in the equipment data compliance booklet and state the guidance on recommended repair methods, either field repair, factory repair, or whole-item replacement.

c. The as-built equipment data booklet shall include the equipment compliance booklet and manufacturer supplied user manuals and information.

d. If the operation manual and the maintenance and repair manual are provided in a common volume, they shall be clearly differentiated and separately indexed.



## 1.7 MAINTENANCE AND SERVICE

Services, materials and equipment shall be provided as necessary to maintain the entire system in an operational state as specified for a period of one year after successful completion and acceptance of the Performance Verification Test. Impacts on facility operations shall be minimized.

### 1.7.1 Description of Work

The adjustment and repair of the system shall include the manufacturer's required adjustments of computer equipment, software updates, transmission equipment and instrumentation and control devices.

### 1.7.2 Personnel

Service personnel shall be qualified to accomplish work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

### 1.7.3 Scheduled Inspections

Two inspections shall be performed at six-month intervals and all work required shall be performed. Inspections shall be scheduled in June and December. These inspections shall include:

- a. Visual checks and operational tests of equipment.
- b. Fan checks and filter changes for control system equipment.
- c. Clean control system equipment including interior and exterior surfaces.
- d. Check and calibrate each field device. Check and calibrate 50 percent of the total analog points during the first inspection. Check and calibrate the remaining 50 percent of the analog points during the second major inspection. Certify analog test instrumentation accuracy to be twice that of the device being calibrated. Randomly check at least 25 percent of all digital points for proper operation during the first inspection. Randomly check at least 25 percent of the remaining digital points during the second inspection.
- e. Run system software diagnostics and correct diagnosed problems.
- f. Resolve any previous outstanding problems.

### 1.7.4 Scheduled Work

This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays.

#### 1.7.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the system. A telephone number where the service supervisor can be reached at all times shall be provided. Service personnel shall be at the site within 24 hours after receiving a request for service. The control system shall be restored to proper operating condition within three calendar days after receiving a request for service.

#### 1.7.6 Operation

Scheduled adjustments and repairs shall include verification of the control system operation as demonstrated by the applicable tests of the performance verification test.

#### 1.7.7 Records and Logs

Dated records and logs shall be kept of each task, with cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain initial analog span and zero calibration values and digital points. Complete logs shall be kept and shall be available for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

#### 1.7.8 Work Requests

Each service call request shall be recorded as received and shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. A record of the work performed shall be submitted within 5 days after work is accomplished.

#### 1.7.9 System Modifications

Recommendations for system modification shall be submitted in writing. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Government. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.

#### 1.7.10 Software

Updates to the software shall be provided for system, operating and application software, and operation in the system shall be verified. Updates shall be incorporated into operations and maintenance manuals, and software documentation. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the latest released version of the Contractor's software shall be installed and validated.

## 1.8 FACTORY TESTING

The Contractor shall assemble the factory test DDC system as specified and shall perform test to demonstrate that the performance of the system satisfies the requirements of this specification. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of data produced, including results of each test procedure during factory testing shall be delivered to the Government at the conclusion of testing, prior to Government approval of the test. The test results documentation shall be arranged so that commands, responses, and data acquired are correlated in a manner which will allow for logical interpretation of the data.

### 1.8.1 Factory Test Setup

The factory test setup shall include the following:

- a. Central workstation/tester.
- b. Printer.
- c. DDC test set.
- d. Portable workstation/tester.
- e. Communication links of each type and speed including MODEMs.
- f. Dial-up MODEM.
- g. Software.

## PART 2 PRODUCTS

### 2.1 GENERAL EQUIPMENT REQUIREMENTS

Units of the same type of equipment shall be products of a single manufacturer. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in a satisfactory commercial or industrial use for two years prior to use on this project. The two years' use shall include applications of equipment and materials under similar circumstances and of similar size. The two years' experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6,000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization. Items of the same type and purpose shall be identical, including equipment, assemblies, parts and components. Automatic temperature controls shall be direct digital controls that will provide the required sequence of

operation.

#### 2.1.1 Electrical and Electronic Devices

Electrical, electronic, and electropneumatic devices not located within a DDC panel shall have a NEMA ICS 1 enclosure in accordance with NEMA 250 unless otherwise shown.

#### 2.1.2 Standard Signals

Except for air distribution terminal unit control equipment, the output of all analog transmitters and the analog input and output of all DDC controllers shall be 4-to-20 mA<sub>dc</sub> signals. The signal shall originate from current-sourcing devices and shall be received by current-sinking devices.

#### 2.1.3 Ambient Temperature Limits

DDC panels shall have ambient condition ratings of 35 to 120 degrees F and 10 to 95 percent relative humidity, noncondensing. Devices installed outdoors shall operate within limit ratings of minus 35 to plus 150 degrees F. Instrumentation and control elements shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.

#### 2.1.4 Year 2000 Compliance

All equipment and software shall be Year 2000 compliant and shall be able to accurately process date/time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, including leap year calculations, when used in accordance with the product documentation provided by the contractor, provided that all products (e.g. hardware, software, firmware) used in combination with other information technology, shall accurately process date/time data if other information technology properly exchanges date/time data with it.

### 2.2 TUBING

#### 2.2.1 Copper

Copper tubing shall conform to ASTM B 88, ASTM B 88M and shall have sweat fittings and valves.

#### 2.2.2 Stainless Steel

Stainless steel tubing shall conform to ASTM A 269 and shall have stainless steel compression fittings.

#### 2.2.3 Plastic

Plastic tubing shall have barbed fittings and valves. Plastic tubing shall have the burning characteristics of linear low-density polyethylene tubing, shall be self-extinguishing when tested in accordance with ASTM D 635,

shall have UL 94 V-2 flammability classification, and shall withstand stress cracking when tested in accordance with ASTM D 1693. Plastic-tubing bundles shall be provided with Mylar barrier and flame-retardant polyethylene jacket.

## 2.3 WIRING

### 2.3.1 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

### 2.3.2 Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 300-volt service.

### 2.3.3 Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 600-volt service.

### 2.3.4 Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single- or multiple-twisted, minimum 2 inch lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

### 2.3.5 Transformers

Step down transformers shall be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformer shall be sized so that the connected load is 80 percent of the rated capacity or less. Transformers shall conform to UL 508 and NEMA ST 1.

## 2.4 ACTUATORS

Actuators shall be electric or electronic as shown and shall be provided with mounting and connecting hardware. Electric or electronic actuators shall be used for variable air volume (VAV) air terminal units. Actuators shall fail to their spring-return positions on signal or power failure. The actuator stroke shall be limited in the direction of power stroke by an adjustable stop. Actuators shall have a visible position indicator. Actuators shall smoothly open or close the devices to which they are applied and shall have a full stroke response time of 90 seconds or less. Electric actuators shall have an oil-immersed gear train. Electric or

electronic actuators operating in series shall have an auxiliary actuator driver. Electric or electronic actuators used in sequencing applications shall have an adjustable operating range and start point. Pneumatic actuators shall be rated for 25 psig operating pressure except for high-pressure cylinder-type actuators.

#### 2.4.1 Valve Actuators

Valve actuators shall be selected to provide a minimum of 125 percent of the motive power necessary to operate the valve over its full range of operation.

#### 2.4.2 Positive Positioners

Positive positioners are required for pneumatic actuators. Each positive positioner shall be a pneumatic relay with a mechanical feedback mechanism and an adjustable operating range and starting point.

### 2.5 AUTOMATIC CONTROL VALVES

Valves shall have stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Unless otherwise stated, valves shall have globe style bodies. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv. Unless otherwise specified, bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends; bodies for 2 inch valves shall have threaded ends; and bodies for valves 2 to 3 inches shall be of brass, bronze or iron. Bodies for valves 2-1/2 inches and larger shall be provided with flanged-end connections. Valve Cv shall be within 100 to 125 percent of the Cv shown.

#### 2.5.1 Butterfly Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service and modulation to the fully-closed position, with carbon-steel bodies and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from minus 20 to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator. The rated Cv for butterfly valves shall be the value Cv at 70% open (60 degrees open).

#### 2.5.2 Two-Way Valves

Two-way modulating valves shall have equal-percentage characteristics.

#### 2.5.3 Three-Way Valves

Three-way valves shall provide linear flow control with constant total flow throughout full plug travel.

#### 2.5.4 Duct-Coil and Terminal-Unit-Coil Valves

Control valves with either flare-type or solder-type ends shall be provided

for duct or terminal-unit coils. Flare nuts shall be furnished for each flare-type end valve.

#### 2.5.5 Valves for Chilled-Water, Condenser-Water, and Glycol Service

Internal valve trim shall be bronze except that valve stems may be type 316 stainless steel. Valve Cv shall be within 100 to 125 percent of the Cv shown. Valves 4 inches and larger shall be butterfly.

#### 2.5.6 Valves for Hot-Water and Dual Temperature Service

For hot water service below 250 degrees F and dual-temperature service, internal trim (including seats, seat rings, modulating plugs, and springs) of valves controlling water hotter than 210 degrees F shall be Type 316 stainless steel. Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze. Nonmetallic parts of hot-water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher. Valves 4 inches and larger shall be butterfly valves.

#### 2.5.7 Valves for Steam Service

Bodies for valves 4 inches and larger shall be iron. Internal valve trim shall be Type 316 stainless steel. Valve Cv shall be not less than shown nor greater than the Cv of the manufacturer's next larger size.

#### 2.5.8 Valves for High-Temperature Hot-Water Service

For high-temperature hot water service above 250 Degrees F, valve bodies shall be rated ANSI Class 300, as specified in ASME B16.34. Valve and actuator combination shall be normally closed. Bodies shall be carbon steel, globe type with welded ends on valves 1 inch and larger. Valves smaller than 1 inch shall have socket-weld ends. Packing shall be virgin polytetrafluoroethylene (PTFE). Internal valve trim shall be Type 316 stainless steel. Valve Cv shall be within 100 to 125 percent of the Cv shown.

### 2.6 DAMPERS

#### 2.6.1 Damper Assembly

A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section shall not be located directly in the air stream. Damper axles shall be 0.5 inch minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gauge at 1,000 feet per minute in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500-D.

### 2.6.2 Operating Links

Operating links external to dampers, such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed positions of dampers.

### 2.6.3 Damper Types

Dampers shall be parallel-blade type.

#### 2.6.3.1 Outside Air, Return Air, and Relief Air Dampers

Outside air, return air and relief air dampers shall be provided where shown. Blades shall have interlocking edges and shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot at 4 inches water gauge static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 to plus 200 degrees F. Dampers shall be rated at not less than 2,000 feet per minute air velocity.

#### 2.6.3.2 Mechanical and Electrical Space Ventilation Dampers

Mechanical and electrical space ventilation dampers shall be as shown. Dampers shall not leak in excess of 80 cfm square foot at 4 inches water gauge static pressure when closed. Dampers shall be rated at not less than 1,500 feet per minute air velocity.

#### 2.6.3.3 Smoke Dampers

Smoke-damper and actuator assembly required per NFPA 90A shall meet the Class II leakage requirements of UL 555S. Dampers shall be rated at not less than 2000 fpm air velocity.

#### 2.6.4 Damper End Switches

Each end switch shall be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

### 2.7 SMOKE DETECTORS

Duct smoke detectors shall be provided in supply and return air ducts in accordance with NFPA 90A. Duct smoke detectors shall conform to the requirements of UL 268A. Duct smoke detectors shall have perforated sampling tubes extended into the air duct. Detector circuitry shall be



mounted in a metallic enclosure exterior to the duct. Detectors shall have manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the fire alarm control panel (FACP). Detectors shall have two sets of normally open alarm contacts and two sets of normally closed alarm contacts. Detectors shall be connected to the building fire alarm panel for alarm initiation. A remote annunciation lamp and accessible remote reset switch shall be provided for duct detectors that are mounted eight feet or more above the finished floor and for detectors that are not readily visible. Remote lamps and switches as well as the affected fan units shall be properly identified in etched rigid plastic placards.

## 2.8 INSTRUMENTATION

### 2.8.1 Measurements

Transmitters shall be calibrated to provide the following measurements, over the indicated ranges, for an output of 4 to 20 mAdc:

- a. Conditioned space temperature, from 50 to 85 degrees F.
- b. Duct temperature, from 40 to 140 degrees F.
- c. High-temperature hot-water temperature, from 200 to 500 degrees F.
- d. Chilled-water temperature, from 30 to 100 degrees F.
- e. Dual-temperature water, from 30 to 240 degrees F.
- f. Heating hot-water temperature, from 50 to 250 degrees F.
- g. Condenser-water temperature, from 30 to 130 degrees F.
- h. Outside-air temperature, from minus 30 to 130 degrees F.
- i. Relative humidity, 0 to 100 percent for space and duct high-limit applications.
- j. Differential pressure for VAV supply-duct static pressure from 0 to 2.0 inches water gauge.
- k. Pitot-tube air-flow measurement station and transmitter, from 0 to 0.1 inch water gauge for flow velocities of 700 to 1200 fpm, 0 to 0.25 inch water gauge for velocities of 700 to 1800 fpm, or 0 to 0.5 inch water gauge for velocities of 700 to 2500 fpm.
- l. Electronic air-flow measurement station and transmitter, from 125 to 2500 fpm.

### 2.8.2 Temperature Instruments

#### 2.8.2.1 Resistance Temperature Detectors (RTD)

Temperature sensors shall be 100 ohms 3- or 4-wire RTD. Each RTD shall be

platinum with a tolerance of 0.54 degrees F at 32 degrees F with a temperature coefficient of resistance (TCR) of .00214 ohms/ohm/deg F and shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Each RTD shall be furnished with an RTD transmitter as specified, integrally mounted unless otherwise shown.

#### 2.8.2.2 Continuous Averaging RTD

Continuous averaging RTDs shall have a tolerance of plus or minus 1.0 degree F at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross section in which it is installed. The sensing element shall have a bendable copper sheath. Each averaging RTD shall be furnished with an RTD transmitter to match the resistance range of the averaging RTD.

#### 2.8.2.3 RTD Transmitter

The RTD transmitter shall match the resistance range of the RTD. The transmitter shall be a two-wire, loop powered device. The transmitter shall produce a linear 4-to-20 mA<sub>dc</sub> output corresponding to the required temperature measurement. The output error shall not exceed 0.1 percent of the calibrated measurement.

#### 2.8.3 Relative Humidity Instruments

A relative-humidity instrument for indoor application shall have a measurement range from 0 to 100 percent relative-humidity and be rated for operation at ambient air temperatures within the range of 25 to 130 degrees F. It shall be capable of being exposed to a condensing air stream (100 percent RH) with no adverse effect to the sensor's calibration or other harm to the instrument. The instrument shall be of the wall-mounted or duct-mounted type, as required by the application, and shall be provided with any required accessories. Instruments used in duct high-limit applications shall have a bulk polymer resistive sensing element. Duct-mounted instruments shall be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. The instrument (sensing element and transmitter) shall be a two-wire, loop-powered device and shall have an accuracy of plus or minus three percent of full scale within the range of 20 to 80 percent relative humidity. The instrument shall have a typical long-term stability of 1 percent or less drift per year. The transmitter shall convert the sensing element's output to a linear 4-20 mA<sub>dc</sub> output signal in proportion to the measured relative-humidity value. The transmitter shall include offset and span adjustments.

#### 2.8.4 Electronic Airflow Measurement Stations and Transmitters

##### 2.8.4.1 Stations

Each station shall consist of an array of velocity sensing elements and an air-flow straightener. Air-flow straightener shall be contained in a flanged sheet metal or aluminum casing. The velocity sensing elements shall be of the RTD or thermistor type, producing a temperature compensated output. The sensing elements shall be distributed across the duct cross

section in the quantity and pattern specified by the published application data of the station manufacturer. The resistance to air flow through the airflow measurement station shall not exceed 0.08 inch water gauge at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflows of up to 5,000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus three percent over a range of 125 to 2,500 fpm. In outside air measurement or in low-temperature air delivery applications, the station shall be certified by the manufacturer to be accurate as specified over a temperature range of minus 20 to plus 120 degrees F. In outside air measurement applications, the air flow straightener shall be constructed of 1/8 inch aluminum honeycomb and the depth of the straightener shall not be less than 1.5 inches.

#### 2.8.4.2 Transmitters

Each transmitter shall produce a linear, 4-to-20 mAdc, output corresponding to the required velocity pressure measurement. The transmitter shall be a two-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the calibrated measurement.

#### 2.8.5 Pitot Tube Airflow Measurement Stations and Transmitters

##### 2.8.5.1 Stations

Each station shall contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements shall be of the multiple pitot tube type with averaging manifolds. The sensing elements shall be distributed across the duct cross section in the quantity and pattern specified by the published installation instructions of the station manufacturer. The resistance to air flow through the airflow measurement station shall not exceed 0.08 inch water gauge at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflows of up to 5,000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus three percent over a range of 500 to 2,500 fpm. This device will not be used if the required velocity measurement is below 700 fpm or for outside airflow measurements.

##### 2.8.5.2 Transmitters

Each transmitter shall produce a linear 4-to-20 mAdc output corresponding to the required velocity pressure measurement. Each transmitter shall have a low range differential pressure sensing element. The transmitter shall be a two-wire, loop powered device. Sensing element accuracy shall be plus or minus one percent of full scale, and overall transmitter accuracy shall be plus or minus 0.25 percent of the calibrated measurement.

#### 2.8.6 Differential Pressure Instruments

The instrument shall be a pressure transmitter with an integral sensing element. The instrument over pressure rating shall be 300 percent of the operating pressure. The sensor/transmitter assembly accuracy shall be plus or minus two percent of full scale. The transmitter shall be a two-wire, loop-powered device. The transmitter shall produce a linear 4-to-20 mAdc

output corresponding to the required pressure measurement.

#### 2.8.7 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 2 inch lagging neck and extension type well. Inside diameter and insertion length shall be as required for the application.

#### 2.8.8 Sunshields

Sunshields for outside air temperature sensing elements shall prevent the sun from directly striking the temperature sensing elements. The sunshields shall be provided with adequate ventilation so that the sensing element responds to the ambient temperature of the surroundings. The top of each sunshield shall have a galvanized metal rainshield projecting over the face of the sunshield. The sunshields shall be painted white.

### 2.9 THERMOSTATS

Thermostat ranges shall be selected so that the setpoint is adjustable without tools between plus or minus 10 degrees F of the setpoint shown. Thermostats shall be electronic or electric.

#### 2.9.1 Nonmodulating Room Thermostats

Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 5 degrees F. Room thermostats shall be enclosed with separate locking covers (guards).

#### 2.9.2 Microprocessor Based Room Thermostats

Microprocessor based thermostats shall have built-in keypads for scheduling of day and night temperature settings. When out of the scheduling mode, thermostats shall have continuous display of time, with AM and PM indicator, continuous display of day of week, and either continuous display of room temperature with display of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature on demand. In the programmable mode, the display shall be used for interrogating time program ON-OFF setpoints for all seven days of the week.

The time program shall allow two separate temperature setback intervals per day. The thermostats shall have a means for temporary and manual override of the program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain the timing and maintain the schedule in memory for one year in the event of a power outage. Maximum differential shall be 2 degrees F. When used for heat pump applications, the thermostat shall have an emergency heat switch.

#### 2.9.3 Modulating Room Thermostats

Modulating room thermostats shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Each thermostat shall have an adjustable throttling range of 4 to 8 degrees F for each output. Room thermostats shall be enclosed with separate locking covers (guards).

## 2.9.4 Nonmodulating Capillary Thermostats and Aquastats

Each thermostat shall have a capillary length of at least 5 feet, shall have adjustable direct-reading scales for both setpoint and differential, and shall have a differential adjustable from 6 to 16 degrees F. Aquastats shall be of the strap on type, with 10 degrees F fixed differential.

## 2.9.5 Freezestats

Freezestats shall be manual reset, low temperature safety thermostats, with NO and NC contacts and a 20 foot element which shall respond to the coldest 18 inch segment.

## 2.9.6 Modulating Capillary Thermostats

Each thermostat shall have either one output signal, two output signals operating in unison, or two output signals operating in sequence, as required for the application. Thermostats shall have adjustable throttling ranges of 4 to 8 degrees F for each output.

## 2.9.7 Fan-Coil Unit Room Thermostats

Fan-coil unit thermostats in personnel living spaces shall be of the low voltage type with locking covers. Electrical rating shall not exceed 2.5 amperes at 30 volts ac. Housing shall be corrosion resisting metal or molded plastic. Transformer and fan relay shall be provided for the proper operation of each thermostatic control system as necessary to suit the design of the control system using the thermostats specified below. Either separate heating thermostats and separate cooling thermostats or dual element heating cooling thermostats may be provided. Motor speed switches shall be provided for three-speed fan control.

## 2.9.7.1 Heating Thermostat

Fan-coil heating thermostats shall be provided with fixed heat anticipation and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Thermostats shall be provided with external temperature setting devices with a factory set maximum of \_\_\_\_\_72 or 68 degrees F. Heating thermostats shall have an adjustable range of at least 13 degrees below \_\_\_\_\_72 or 68 degrees F.

## 2.9.7.2 Cooling Thermostat

Fan-coil cooling thermostats shall be provided with fixed cooling anticipation heater and shall have a single-pole, single-throw (SPST) switch hermetically sealed and actuated by a bimetallic or bellows type element. Thermostats shall be provided with external temperature setting devices with a factory set minimum of 78 degrees F. Cooling thermostats shall have an adjustable range of at least 7 degrees above 78 degrees F.

## 2.9.7.3 Combination Thermostat

Fan coil unit combination heating-cooling thermostats shall be provided with separate temperature sensing elements for each system, and shall have a single-pole, single-throw (SPST) switch, hermetically sealed and actuated by a bimetallic or bellows type element. Each element shall operate switches to provide single stage control for heating and cooling. Scales and ranges shall be as specified for individual thermostats. Thermostats shall contain, or a subbase shall be provided which contains, selector switches for Heat-Off-Cool. A changeover controller providing automatic summer-winter changeover for thermostats by sensing the supplied fluid temperature shall be provided. A limited range heating-cooling dead band thermostat shall control cooling when temperature is above the upper setpoint and heating when temperature is below the lower setpoint and shall have a dead band, with no heating or cooling, when temperature is between the setpoints. Setpoint adjustment shall be concealed.

## 2.10 PRESSURE SWITCHES AND SOLENOID VALVES

## 2.10.1 Pressure Switches

Each switch shall have an adjustable setpoint with visible setpoint scale. Range shall be as shown. Differential adjustment shall span 20 to 40 percent of the range of the device.

## 2.10.2 Differential-Pressure Switches

Each switch shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. These fittings shall be of the angled-tip type with tips pointing into the air stream. The setpoint shall not be in the upper or lower quarters of the range and the range shall not be more than three times the setpoint. Differential shall be a maximum of 0.15 inch water gauge at the low end of the range and 0.35 inch water gauge at the high end of the range.

## 2.10.3 Pneumatic Electric (PE) Switches

Each switch shall have an adjustable setpoint range of 3 to 20 psig with a switching differential adjustable from 2 to 5 psig. The switch action shall be SPDT.

## 2.10.4 Solenoid-Operated Pneumatic (EP) Valves

Each valve shall have three-port operation: common, normally open, and normally closed. Each valve shall have an outer cast aluminum body and internal parts of brass, bronze, or stainless steel. The air connection shall be a 3/8 inch NPT threaded connection. Valves shall be rated for 50 psig when used in a control system that operates at 25 psig or less, or 150 psig when used in a control system that operates in the range of 25 to 100 psig.

## 2.11 INDICATING DEVICES

## 2.11.1 Thermometers

Mercury shall not be used in thermometers.

## 2.11.1.1 Piping System Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.

## 2.11.1.2 Piping System Thermometer Stems

Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

## 2.11.1.3 Nonaveraging Air-Duct Thermometers

Air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

## 2.11.1.4 Averaging Air-Duct Thermometers

Averaging thermometers shall have a 3-1/2 inch (nominal) dial, with black legend on white background, and pointer traveling through a 270-degree arc.

## 2.11.1.5 Accuracy

Thermometers shall have an accuracy of plus or minus one percent of scale range. Thermometers shall have a range suitable for the application.

## 2.11.2 Pressure Gauges

Gauges shall be 2 inch (nominal) size, back connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus three percent of scale range. Gauges shall meet requirements of ASME B40.1.

## 2.11.2.1 Pneumatic Actuator Gauges

Gauges for indicating signal output to pneumatic actuators shall have an outer scale of 3 to 15 psig in 1 psig graduations.

## 2.11.2.2 Air Storage Tank and Filter and Dryer Gauge

Gauges for air storage tanks or for use before and after dirt and oil filters or dryers, shall have a scale of 0 to 160 psig with 2 psig graduations.

## 2.11.2.3 Hydronic System Gauges

Gauges for hydronic system applications shall have ranges and graduations as shown.

## 2.11.3 Low Differential Pressure Gauges

Gauges for low differential pressure measurements shall be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauges shall have ranges and graduations as shown. Accuracy shall be plus or minus two percent of scale range.

## 2.12 CONTROL DEVICES AND ACCESSORIES

## 2.12.1 Relays

Control relay contacts shall have utilization category and ratings selected for the application, with a minimum of two sets of contacts (two normally open, two normally closed) enclosed in a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage. Time delay relays shall be 2PDT with eight-pin connectors, dust cover, and a matching rail-mounted socket. Adjustable timing range shall be 0 to 5 minutes. Power consumption shall not be greater than three watts.

## 2.12.2 Current to Pneumatic (IP) Transducers

The transducers shall be two-wire current-to-pressure transmitters that convert a 4-to-20 mA<sub>dc</sub> input signal to a 3 to 15 psig, or a 15 to 3 psig, pneumatic output, with a conversion accuracy of plus or minus two percent of full scale, including linearity and hysteresis. Input impedance shall not exceed 250 ohms. Air consumption shall not be greater than 0.25 scfm.

## 2.12.3 Joule or Watthour Meters

Watthour meters shall be in accordance with ANSI C12.1 and have pulse initiators for remote monitoring of Watthour consumption. Pulse initiator shall consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets shall be in accordance with ANSI C12.1.

## 2.12.4 Joule or Watthour Meters with Demand Register

Meters shall be in accordance with ANSI C12.1 and shall have pulse initiators for remote monitoring of Watthour consumption and instantaneous demand. Pulse initiators shall consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets shall be in accordance with ANSI C12.1



#### 2.12.5 Joule or Watthour Transducers

Watthour transducers shall have an accuracy of plus or minus 0.25 percent for kW and kWh outputs from full lag to full lead power factor. Input ranges for kW and kWh transducers shall be selectable without requiring the changing of current or potential transformers. The output shall be 4 to 20 mAdc.

#### 2.12.6 Current Sensing Relays

Current sensing relays shall provide a normally-open contact rated at a minimum of 50 volts peak and 1/2 ampere or 25 VA, noninductive. There shall be a single hole for passage of current carrying conductors. The devices shall be sized for operation at 50 percent rated current based on the connected load. Voltage isolation shall be a minimum of 600 volts.

#### 2.12.7 Power-Line Conditioners (PLC)

Power line conditioners shall be furnished for each DDC panel. The PLCs shall provide both voltage regulation and noise rejection. The PLCs shall be of the ferro-resonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power-line side. The PLCs shall be sized for 125 percent of the actual connected kVA load. Characteristics of the PLC shall be as follows:

a. At 85 percent load, the output voltage shall not deviate by more than plus or minus one percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.

b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus three percent of nominal voltage. Full correction of load switching disturbances shall be accomplished within five cycles, and 95 percent correction shall be accomplished within two cycles of the onset of the disturbance.

c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

### 2.13 COMPRESSED AIR STATIONS

#### 2.13.1 Air Compressor Assembly

The air compressor shall be a high pressure compressing unit with electric motor. The compressor shall be equipped with a motor with totally enclosed belt guard, an operating-pressure switch, safety relief valves, gauges, intake filter and intake silencer, and combination type magnetic starter with undervoltage protection and thermal-overload protection for each phase, and shall be supported by a steel base mounted on an air storage tank. The air compressor shall provide the compressed air required for control operation while operating not more than one-third of the time. The air storage tank shall be fabricated for a working pressure of not less than 200 psig, and constructed and certified in accordance with ASME BPVC SEC VIII D1. The tank shall be of sufficient volume so that no more than six compressor starts per hour are required with the starting pressure

switch differential set at 20 psig. The tank shall be provided with an automatic condensate drain trap with manual override feature. A second (duplex arrangement) compressor of capacity equal to the primary compressor shall be provided, with interlocked control to provide automatic changeover upon malfunction or failure of either compressor. A manual selector switch shall be provided to index the lead compressor including the automatic changeover.

#### 2.13.2 Compressed Air Station Specialties

##### 2.13.2.1 Refrigerated Dryer, Filters and, Pressure Regulator

A refrigerated dryer shall be provided in the air outlet line of the air storage tank. The dryer shall be of the size required for the full delivery capacity of the compressor. The air shall be dried at a pressure of not less than 70 psig to a temperature not greater than 35 degrees F. The dryer shall be provided with an automatic condensate drain trap with manual override feature. The refrigerant used in the dryer shall be one of the fluorocarbon gases and have an Ozone Depletion Potential of not more than 0.05. A five micron prefilter and coalescing-type 0.03 micron oil removal filter with shut-off valves shall be provided in the dryer discharge. Each filter bowl shall be rated for 150 psig maximum working pressure. A pressure regulator, with high side and low side pressure gauges, and a safety valve shall be provided downstream of the filter. Pressure regulators of the relieving type shall not be used.

##### 2.13.2.2 Flexible Pipe Connections

The flexible pipe connectors shall be designed for 150 psig and 250 degrees F service, and shall be constructed of rubber, tetrafluoroethylene resin, or braided corrosion-resistant steel, bronze, monel, or galvanized steel. The connectors shall be suitable for the service intended and may have threaded or soldered ends. The length of the connectors shall be as recommended by the manufacturer for the service intended.

##### 2.13.2.3 Vibration Isolation Units

The vibration isolation units shall be standard products with published loading ratings, and shall be single rubber-in-shear, double rubber-in-shear, or spring type.

##### 2.13.2.4 Compressed Air Piping

Control air delivered to the system shall conform to ISA S7.0.01. Air lines for pneumatic controls shall be seamless copper tubing or nonmetallic tubing. Air lines shall be concealed except in mechanical rooms and other areas where other tubing and piping is exposed. Air lines in exposed and concealed locations, free standing or enclosed in the conduit or other protective coverings, shall be run parallel to the building lines and shall be adequately supported from the building structure, at least every 6 feet horizontally and every 8 feet vertically. Copper tubing shall be hard-drawn in exposed areas and either hard-drawn or annealed in concealed areas. Only tool-made bends shall be used. Fittings for copper tubing shall be brass or copper solder joint type except at connections to

apparatus, where fittings shall be brass compression type. Nonmetallic tubing shall be compounded from polyethylene, meeting the stress crack test of ASTM D 1693. Nonmetallic individual tube polyethylene or multitube instrument tubing bundle shall be classified as flame retardant under UL 94.

The polyethylene material shall be rated as self-extinguishing when tested in accordance with ASTM D 635. Nonmetallic tubing shall be run within covered rigid metallic raceway, rigid conduit or electric metallic tubing except as indicated. Single nonmetallic tubing in a protective sheath, run parallel to the building lines and supported as indicated above, may be used above accessible ceilings and in other concealed but accessible locations. Air lines concealed in walls shall be hard-drawn copper tubing or nonmetallic tubing in rigid conduit. Terminal single lines shall be hard-drawn copper tubing, except when the run is less than 12 inches in length, flexible polyethylene may be used. Nonmetallic tubing will not be used for applications where the tubing could be subjected to a temperature exceeding 130 degrees F. Except in walls and exposed locations, nonmetallic multitube instrument tubing bundle without conduit or metallic raceway protection, may be used where a number of air lines run to the same points, provided the multitube bundle is enclosed in a protective sheath, is run parallel to the building lines and is adequately supported as indicated above. Air lines shall be tested periodically for leaks during installation. Air lines shall be purged of dirt, impurities and moisture before connecting to the control equipment. Fittings for nonmetallic tubing shall be for instrument service and may be brass or acetal resin of the compression or barbed push-on type. Air lines shall be number coded or color coded and keyed to the submittal drawings for future identification and servicing the control system.

## 2.14 DIRECT DIGITAL CONTROL (DDC) HARDWARE

All functions, constraints, data base parameters, operator developed programs and any other data shall be downloadable from a portable workstation/tester or the central workstation/tester to network control panels, RIU's, universal programmable controllers, and unitary controllers.

Download shall be accomplished through both the primary network and the local DDC portable workstation/tester port.

### 2.14.1 Network Control Panel

Network control panels shall be microcomputer-based with sufficient memory provided to perform all specified and shown network control panel functions and operations, including spare capacity for all spares and its I/O functions specified. Each network control panel and remote I/O units (RIU) shall have a minimum of 10% of its I/O functions as spare capacity but not less than 2 of each type used in each. The type of spares shall be in the same proportion as the implemented I/O functions on the panel, but in no case shall there be less than two spare points of each type. The panel I/O functions shall be furnished complete, with no changes or additions necessary to support implementation of spare functions. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. Implementation of spare points shall necessitate only providing the additional field sensor or control device, field wiring including connection to the system, and point definition assignment by the operator

using the central workstation/tester or portable workstation/tester. The panel shall contain all necessary I/O functions to connect to field sensors and control panels. I/O function operation shall be fully supervised to detect I/O function failures. Network control panels shall operate in an independent stand-alone mode, which is defined as all network control panel operations performed by the network control panel without any continuing input from other Direct digital controls or portable workstation/tester. The network control panel shall be capable of controlling a mix of at least 32 RIUs, unitary controllers, and universal programmable controllers.

#### 2.14.1.1 Integral Features

The network control panel shall include:

- a. Main power switch.
- b. Power on indicator.
- c. Portable workstation/tester port, connector, and if necessary power supply.
- d. Manufacturers control network port.
- e. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the field panel, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the panel for further processing.
- f. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.
- g. An intrusion detection device, connected as an alarm.

#### 2.14.1.2 Communication Interfaces

The following communication capabilities shall function simultaneously.

- a. Manufacturers Control Network. Manufacturers control network communications interfaces for each data transmission systems (DTS) circuit between network control panels and RIUs, unitary controllers, and universal programmable controllers, shall be provided. Communication interfaces shall be provided between each network control panel and associated I/O functions. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the network control panel enclosure.
- b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. Network control panel workstation/tester port other than RS-232, shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel.

c. Primary Network Port. The network control panel shall either have a built in primary network Port or be capable of accepting a primary network port expansion card for future networking to a base wide utility monitoring and control system (UMCS). The primary network port expansion card shall be either Ethernet (IEEE802.3) or ARCNET.

#### 2.14.1.3 Memory and Real Time Clock (RTC) Backup

The network control panel memory and real time clock functions shall continue to operate for a minimum of 72 hours in the event of a power failure. If rechargeable batteries are provided, automatic charging of batteries shall be provided. Whenever a either a permanent workstation/tester or portable workstation/tester is monitoring the network control panel, a low battery alarm message shall be sent to it.

#### 2.14.1.4 Duplex Outlet

A single phase, 120 Vac electrical service outlet for use with test equipment shall be furnished either inside or within 6 feet of the network control panel enclosure.

#### 2.14.1.5 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each network control panel.

#### 2.14.1.6 Failure Mode

Upon failure of the network control panel, either due to failure of the network control panel hardware or of the manufacturers control network, the network control panel shall revert to the failure mode as shown.

a. Manufacturers Control Network Failure: Upon failure of the manufacturers control network, the network control panel shall operate in an independent stand-alone mode.

b. Network Control Panel Hardware Failure: Upon failure of the network control panel hardware, the network control panel shall cease operation and stop communications with other network control panels, RIUs, unitary controllers and universal programmable controllers connected to the affected network control panel. The affected network control panel shall respond to this failure as specified and shown.

#### 2.14.2 RIU

The RIU shall be functionally a part of the network control panel as specified, but may be remotely located from the network control panel and communicate over a dedicated communication circuit. When remotely located, the I/O functions shall be subject to the same requirements as for the network control panel hardware. RIUs shall be used to connect remote inputs and outputs to a network control panel and shall contain all necessary I/O functions to connect to field sensors and control devices. RIU operation shall be fully supervised by the network control panel to

detect failures. Each RIU shall have a minimum of 10 % of its I/O functions as spare capacity. The type of spares shall be in the same proportion as the implemented I/O functions on the RIU, but in no case shall there be less than two spare points of each type. The RIU shall be furnished complete, with no changes or additions necessary to support implementation of spare functions. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. Implementation of spare points by others shall require only providing the additional field sensor or control device, field wiring including connection to the system, and point definition assignment by the operator. The RIU shall either report the status of all connected points on each scan, or report the status of all points which have changed state or value since the previous scan.

#### 2.14.2.1 Integral Features

The RIU shall include:

- a. Main power switch.
- b. Power on indicator.
- c. Portable workstation/tester port, connector, and if necessary power supply.
- d. Manufacturers control network port.
- e. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the RIU, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the RIU for further processing.
- f. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.
- g. An intrusion detection device, connected as an alarm.

#### 2.14.2.2 Duplex Outlet

A single phase, 120 Vac electrical service outlet for use with test equipment shall be furnished either inside or within 6 feet of the RIU.

#### 2.14.2.3 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each RIU.

#### 2.14.2.4 Failure Mode

Upon failure of the RIU, either due to failure of the RIU hardware or of the DTS, the RIU shall revert to the failure mode shown.

## 2.14.3 Universal Programmable Controller (UPC)

The universal programmable controller shall be a microprocessor based controller designed and programmed to control and monitor systems as shown.

Resident programs shall be contained in reprogrammable nonvolatile memory. Each universal programmable controller shall contain necessary power supplies, transformers, memory, I/O functions and communications interfaces necessary to perform its required functions and to provide control and monitoring of connected equipment and devices. It shall contain all necessary I/O functions to connect to field sensors and controls. I/O operation shall be fully supervised to detect I/O function failures. It shall provide for operation as a device connected to the system via the manufacturers control network.

## 2.14.3.1 Integral Features

The universal programmable controller shall include as a minimum:

- a. Main power switch.
- b. Power on indicator.
- c. Portable workstation/tester port, connector, and if necessary power supply.
- d. Manufacturers control network port.
- e. I/O functions
  - (1) 8 DI
  - (2) 4 DO
  - (3) 8 AI
  - (4) 4 AO
  - (5) 1 PA
- f. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the universal programmable controller, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the panel for further processing.
- g. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.

## 2.14.3.2 Communication Interfaces

The UPC shall have the following communication capabilities which shall

function simultaneously.

a. Manufacturers Control Network. The manufacturers control network communications interface for a data transmission systems (DTS) circuit between the UPC and a network control panels shall be provided. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the UPC Panel enclosure.

b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. A UPC workstation/tester port other than RS-232, shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel.

#### 2.14.3.3 Memory and RTC Backup

The UPC memory and real time clock functions shall continue to operate for a minimum of 72 hours in the event of a power failure. If rechargeable batteries are provided, automatic charging of batteries shall be provided. Whenever either a permanent workstation/tester or portable workstation/tester is monitoring the network control panel, a low battery alarm message shall be sent to it.

#### 2.14.3.4 Specific Requirements

Each universal programmable controller shall be accessible for purposes of application selection, control parameters, set point adjustment, and monitoring from any DDC controller connected to the same manufacturers control network as the universal programmable controller. This shall be done using a portable workstation/tester connected to a portable workstation/tester port either directly or via modem.

#### 2.14.3.5 Locking Enclosures

Locking type mounting cabinets with common keying shall be furnished for each enclosure.

#### 2.14.3.6 Failure Mode

Upon failure of the universal programmable controller, it shall revert to the failure mode of operation as shown.

#### 2.14.4 Unitary Controller

The unitary controller shall be a microprocessor based, stand-alone, dedicated purpose controller, communicating with the network control panel, designed and programmed to control air distribution system mixing boxes, terminal units, heat pumps, fan coil units, self-contained DX units or VAV boxes as shown. Each unitary controller shall contain resident programs in nonvolatile memory for each specific application implemented. Each unitary controller shall contain necessary power supplies, transformers, memory, I/O functions and communications interfaces necessary to perform its required functions and to provide control and monitoring of connected



equipment and devices. It shall contain all necessary I/O functions to connect to field sensors and controls. I/O operation shall be fully supervised to detect I/O function failures and shall provide for operation as a device connected to the network control panel via the manufacturers control network.

#### 2.14.4.1 Integral Features

The unitary controller shall include:

- a. Main power switch.
- b. Power on indicator.
- c. Portable workstation/tester port, connector, and power supply.
- d. Manufacturers control network port.
- e. All I/O functions required to implement the requirements as shown.
- f. On-Off-Auto switches for each DO which controls a device. These switches shall be mounted in the field panel, with the exception of motors, for which the switch shall be mounted at the motor control center. On-Off-Auto switches are not required for DO associated with a status or alarm such as pilot lights. The status of these switches shall be available to the panel for further processing.
- g. Minimum-Maximum-Auto switches, or Auto-Manual switches with manual output override, for each AO. The status of these shall be available to the panel for further processing.

#### 2.14.4.2 Communication Interfaces

The unitary controller shall have the following communication capabilities which shall function simultaneously.

- a. Manufacturers Control Network. The manufacturers control network communications interface for a data transmission systems (DTS) circuit between the unitary controller and a network control panel shall be provided. The DTS will provide for transmission speeds necessary to comply with performance requirements specified. DTS equipment shall be installed in the unitary control panel enclosure.
- b. Portable Workstation/Tester Port. A communications port for interfacing to a portable workstation/tester shall be provided. A unitary controller workstation/tester port other than RS-232, shall be converted to RS-232, including cabling and power supply, and shall be permanently installed in the panel. For unitary controller applications where the controller is not mounted in an enclosure, such as for fan-coil units or VAV terminal units, a portable conversion device for an RS-232 connection to the portable workstation/tester may be provided.

## 2.14.4.3 Specific Requirements

Unitary controller components for new air distribution terminal units shall be furnished to the air distribution terminal unit manufacturer for factory mounting and calibration. Existing air distribution terminal units shall be controlled by field installed unitary controllers.

a. Accessibility and Interfaces: Each unitary controller shall be accessible for purposes of application selection, control parameters, set point adjustment, and monitoring using a portable workstation/tester connected to the manufacturers control network. They shall also be accessible with a portable workstation/tester connected to the unitary controller portable workstation/tester port.

b. Air Distribution Terminal Unit Controls - Pressure Independent: Controls shall consist of a transducer for connection to the velocity-sensing device provided by the terminal unit supplier in the primary air entering the terminal unit, a room temperature sensor, a damper actuator, and an adjustable microprocessor-based controller. The room temperature sensor shall have occupant setpoint adjustment and temperature display, timed override of unoccupied mode, and a communication port. The controller shall operate the damper for cooling and heating and provide control outputs for duct heating coil if applicable. This controller capability shall allow the sequencing of the damper and the heating coil to maintain conditions in the space.

c. Air Distribution Terminal Unit Controls - Pressure Independent with Recirculating Fan: Controls for pressure-independent boxes with recirculating fans shall consist of a transducer for connection to the velocity-sensing device provided by the terminal unit supplier in the primary air entering the terminal unit, a room temperature sensing element, a damper actuator, an adjustable microprocessor-based terminal unit controller, and a switch to operate the recirculation fan, provided by the terminal unit supplier. The room temperature sensor shall have occupant setpoint adjustment and temperature display, timed override of unoccupied mode, and a communication port. The controller shall operate the damper for cooling and shall provide outputs for controlling the recirculation fan and duct heating coil in sequence for heating.

d. Air Distribution Terminal Unit Damper Actuator: Air distribution terminal unit damper actuator shall open or close the device to which it is connected within 60 seconds. The damper actuator shall utilize spring return to fail to the position shown on loss of power or control signal.

## 2.14.4.4 Failure Mode

Upon failure of the unitary controller, it shall revert to the failure mode of operation as shown.

## 2.14.5 Chiller Control Panel

Chiller control panel shall be microprocessor-based and shall provide, both locally and through the Manufacturers Control Network, the control, monitoring, and safety equipment functions provided by the chiller

manufacturer's control panel(s) (two communications ports total). The chiller control panel instrumentation and control ranges and accuracies shall match those of the chiller manufacturer's control devices. The chiller panel shall have a communication port for interface to a Portable Workstation/Tester through either the Manufacturers Control Network or modem for chiller(s) start/stop, chilled water temperature reset, and monitoring of chiller operating status, alarms, and power consumption.

#### 2.14.6 I/O Functions

##### 2.14.6.1 DDC Hardware I/O Functions

I/O Functions shall be provided as part of the DDC system and shall be in accordance with the following:

a. The analog input (AI) function shall monitor each analog input, perform A-to-D conversion, and hold the digital value in a buffer for interrogation. The A-to-D conversion shall have a minimum resolution of 10 bits plus sign. Signal conditioning shall be provided for each analog input. Analog inputs shall be individually calibrated for zero and span, in hardware or in software. The AI shall incorporate common mode noise rejection of 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of 20 dB at 60 Hz from a source impedance of 10,000 ohms. Input ranges shall be within the range of 4-to-20 mAdc.

b. The analog output (AO) function shall accept digital data, perform D-to-A conversion, and output a signal within the range of 4-to-20 mAdc. D-to-A conversion shall have a minimum resolution of eight bits plus sign. Analog outputs shall be individually calibrated for zero and span. Short circuit protection on voltage outputs and open circuit protection on current outputs shall be provided. An individual gradual switch for manual override of each analog output and means of physically securing access to these switches shall be provided. Each AO shall have a three-position switch for selection of the DDC control signal, no control, or a locally generated control signal for connection to the controlled device. Feedback shall be provided to the system as to the status of the output (manual control or automatic). Switches for pneumatic control outputs shall provide a connection for an externally generated pneumatic signal. All switches shall be either of a key operated design with the same keying system used for other outputs or otherwise suitably protected from unauthorized access.

c. The digital input (DI) function shall accept on-off, open-close, or other change of state (two state data) indications. Isolation and protection against an applied steady-state voltage up to 180 Vac peak shall be provided.

d. The digital output (DO) function shall provide contact closures for momentary and maintained operation of output devices. Closures shall have a minimum duration of 0.1 second. DO relays shall have an initial breakdown voltage between contacts and coil of at least 500 V peak. Electromagnetic interference suppression shall be furnished on all output lines to limit transients to nondamaging levels. Protection against an applied steady-state voltage up to 180 Vac peak shall be provided. Minimum

contact rating shall be one ampere at 24 Vac. Key locked HOA switches shall be provided for manual override of each digital output. Feedback shall be provided to the system as to the status of the output (manual control or automatic). Switches shall be common keyed.

e. The pulse accumulator function shall have the same characteristics as the DI. In addition, a buffer shall be provided to totalize pulses and allow for interrogation by the DDC system. The pulse accumulator shall accept rates up to 20 pulses per second. The totalized value shall be reset to zero upon operator's command.

f. Signal conditioning for sensors shall be provided as specified.

g. The binary coded decimal (BCD) function: The BCD function shall have the same characteristics as the DI, except that, in addition, a buffer shall be provided to totalize inputs and allow for interrogation by the network control panel. The BCD function shall have 16-channel optically isolated buffered inputs to read four digit numbers. The BCD function shall accumulate inputs at rates up to 10 inputs per second.

#### 2.14.6.2 Failure Mode

Upon failure of the I/O function, including data transmission failure, logic power supply failure, DDC processor malfunction, software failure, interposing relay power failure, or any other failure which prevents stand alone operation of any DDC normally capable of stand alone operation, connected outputs shall be forced to the failure mode shown.

#### 2.14.7 Portable Workstation/Tester

A portable workstation/tester shall be provided and shall be able to connect to any DDC hardware. The portable workstation/tester shall consist of a portable computer with a nominal 10 inch active color matrix liquid crystal display, capable of displaying up to 256 colors at a minimum resolution of 640 X 480 pixels, an external VGA monitor port, 32 bit microprocessor operating at a minimum of 100 MHZ. The portable workstation/tester shall have, as a minimum, a 1200 MB hard drive, 16 megabytes of memory, integral pointing device, serial and parallel ports, color VGA video port for an external color monitor, 3.5 inch floppy disk drive, modem, PCMCIA type 3 slot, rechargeable battery, battery charger and 120 Vac power supply. It shall include carrying case, extra battery, charger and a compatible network adapter. The workstation/tester shall:

- a. Run DDC diagnostics.
- b. Load all DDC memory resident programs and information, including parameters and constraints.
- c. Display any AI, DI, AO, DO, or PA point in engineering units for analog points or status for digital points.
- d. Control any AO or DO.
- e. Provide an operator interface, contingent on password level,

allowing the operator to use full English language words and acronyms, or an object oriented graphical user interface.

- f. Display database parameters.
- g. Modify database parameters.
- h. Accept DDC software and information for subsequent loading into a specific DDC. Provide all necessary software and hardware required to support this function, including an EIA ANSI/EIA/TIA-232-F port.
- i. Disable/enable each DDC.
- j. Perform all workstation functions as specified.

#### 2.14.8 Central Workstation/Tester

A central workstation/tester shall be provided and shall be able to communicate any network control panel via the primary network. The central workstation/tester shall be functionally equivalent to the portable workstation/tester but is intended to be a stationary unit. The central workstation/tester shall consist of a central computer with a nominal 14 inch VGA color display, capable of displaying up to 256 colors at a minimum resolution of 640 X 480 pixels, 32 bit microprocessor operating at a minimum of 100 MHZ. The central workstation/tester shall have, as a minimum, a 2100 MB hard drive, 32 megabytes of memory, integral pointing device, serial and parallel ports, color VGA video port for an external color monitor, 3.5 inch floppy disk drive, modem, PCMCIA type three slot, rechargeable battery, battery charger, 120 Vac power supply and network adapter (Ethernet IEEE802.3 or ARCNET). The central workstation/tester shall:

- a. Run DDC diagnostics.
- b. Load all DDC memory resident programs and information, including parameters and constraints.
- c. Display any AI, DI, AO, DO, or PA point in engineering units for analog points or status for digital points.
- d. Control any AO or DO.
- e. Provide an operator interface, contingent on password level, allowing the operator to use full English language words and acronyms, or an object oriented graphical user interface.
- f. Display database parameters.
- g. Modify database parameters.
- h. Accept DDC software and information for subsequent loading into a specific DDC. Provide all necessary software and hardware required to support this function, including an EIA ANSI/EIA/TIA-232-F port.

- i. Disable/enable each DDC.
- j. Perform all workstation functions as specified.

#### 2.14.9 Data Terminal Cabinet (DTC)

The DTC shall be an independent metallic enclosure not physically part of the network control panel/RIU as shown. The DTC shall be sized to accommodate the number of I/O functions required for each network control panel/RIU, including installed spares, plus 10% expansion for each type of I/O function provided. The DTC shall be divided into analog input and output groups and digital input and output groups. The DTC shall be provided with double sided screw type terminal strips. One side of the terminal strip shall be used for termination of field wiring from instrumentation-mentation and controls. The other side shall be used to connect the DTC to the network control panel/RIU. Terminal strips shall have individual terminal identification numbers. The DTC shall be a locking type mounting enclosure, with common keying and door switch wired to an input for intrusion alarm annunciation at the central station. DTC keying shall be identical to network control panel/RIU keying.

#### 2.15 DDC SOFTWARE

All DDC software described in this specification shall be furnished as part of the complete DDC System.

##### 2.15.1 Operating System

Each DDC shall contain an operating system that controls and schedules that DDC's activities in real time. The DDC shall maintain a point database in its memory that includes all parameters, constraints, and the latest value or status of all points connected to that DDC. The execution of DDC application programs shall utilize the data in memory resident files. The operating system shall include a real time clock function that maintains the seconds, minutes, hours, date and month, including day of the week. Each DDC real time clock shall be automatically synchronized with the network control panel real time clock at least once per day to plus or minus 10 seconds. When the network control panel is connected to a central workstation/tester, the network control panel RTC shall be updated by the central workstation/tester RTC. The time synchronization shall be accomplished without operator intervention and without requiring system shutdown. The operating system shall allow loading of software, data files data entry, and diagnostics from the central workstation/tester both locally through the central workstation/tester port and remotely through a network control panel and the manufacturers control network.

##### 2.15.1.1 Startup

The DDC shall have startup software that causes automatic commencement of operation without human intervention, including startup of all connected I/O functions. A DDC restart program based on detection of power failure at the DDC shall be included in the DDC software. Upon restoration of power to the DDC, the program shall restart equipment and restore loads to the state at time of power failure, or to the state as commanded by time

programs or other overriding programs. The restart program shall include start time delays between successive commands to prevent demand surges or overload trips. The startup software shall initiate operation of self-test diagnostic routines. Upon failure of the DDC, if the database and application software are no longer resident or if the clock cannot be read, the DDC shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made. If the database and application programs are resident, the DDC shall resume operation after an adjustable time delay of from 0 to 600 seconds. The startup sequence for each DDC shall include a unique time delay setting for each control output when system operation is initiated.

#### 2.15.1.2 Operating Mode

Each DDC shall control and monitor functions as specified, independent of communications with other DDC. This software shall perform all DDC functions and DDC resident application programs as specified using data obtained from I/O functions and based upon the DDC real time clock function. When communications circuits between the DDC are operable, the DDC shall obtain real time clock updates and any required global data values transmitted from other network control panels. The DDC software shall execute commands after performing constraints checks in the DDC. Status and analog values, including alarms and other data shall be transmitted from other network control panels when communications circuits are operable. If communications are not available, each DDC shall function in stand-alone mode and operational data, including the latest status and value of each point and results of calculations, normally transmitted from other network control panels shall be stored for later transmission to the network control panel. Storage for the latest 256 values shall be provided at each network control panel. Each DDC shall accept software downloaded from the network control panel. Constraints shall reside at the DDC.

#### 2.15.1.3 Failure Mode

Upon failure for any reason, each DDC shall perform an orderly shutdown and force all DDC outputs to a predetermined (failure mode) state, consistent with the failure modes shown and the associated control device.

#### 2.15.2 Functions

The Contractor shall provide software necessary to accomplish the following functions, as appropriate, fully implemented and operational, within each network control panel, RIU, unitary controller and universal programmable controller.

- a. Scanning of inputs.
- b. Control of outputs.
- c. Reporting of analog changes outside a selectable differential.
- d. Reporting of unauthorized digital status.
- e. Reporting of alarms automatically to network control panel.

- f. Reporting of I/O status to network control panel upon request.
- g. Maintenance of real time, updated by the network control panel at least once a day.
- h. Communication with the network control panel.
- i. Execution of DDC resident application programs.
- j. Averaging or filtering of AIs.
- k. Constraints checks (prior to command issuance).
- l. Diagnostics.
- m. Portable workstation/tester operation as specified.
- n. Reset of PA by operator based on time and value.

#### 2.15.2.1 Analog Monitoring

The system shall measure and transmit analog values including calculated analog points. An analog change in value is defined as a change exceeding a preset differential value as specified. The record transmitted for each analog value shall include a readily identifiable flag which indicates the abnormal status of the value when it deviates from operator selectable upper and lower analog limits. Analog values shall be expressed in proper engineering units with sign. Engineering units conversions shall be provided for each measurement. Each engineering units conversion set shall include range, span, and conversion equation. A vocabulary of engineering unit descriptors shall be provided, using at least three alphanumeric characters to identify information in the system. The system shall support 255 different engineering units.

#### 2.15.2.2 Logic (Virtual) Points

Logic (virtual) points shall be software points entered in the point database which are not directly associated with a physical I/O function. Logic (virtual) points shall be analog or digital points created by calculation from any combination of digital and analog points, or other data having the properties of real points, including alarms, without the associated hardware. Logic (virtual) points shall be defined or calculated and entered into the database by the Contractor. The calculated analog point shall have point identification in the same format as any other analog point. The calculated point shall be used in any program where the real value is not obtainable directly. Constants used in calculations shall be changeable on-line by the operator. Calculated point values shall be current for use by the system within 10 seconds of the time of any input changes.

#### 2.15.2.3 State Variables

If an analog point represents more than two (up to eight) specific states,



each state shall be nameable. For example, a level sensor shall be displayed at its measured engineering units plus a state variable with named states usable in programs or for display such as low alarm/low/normal/high/high alarm.

#### 2.15.2.4 Analog Totalization

Any analog point shall be operator assignable to the totalization program. Up to eight analog values shall be totalized within a selectable time period. At the end of the period, the totals shall be stored. Totalization shall then restart from zero for the next time period. The program shall keep track of the peak and total value measured during the current period and for the previous period. The operator shall be able to set or reset each totalized value individually. The time period shall be able to be operator defined, modified or deleted on-line.

#### 2.15.2.5 Energy Totalization

The system shall calculate the heat energy in Btus, for each energy source consumed by the mechanical systems specified, totalize the calculated Btus, the instantaneous rate in Btus per hour, and store totals in thousands of Btus (MBtu). The Btus calculated shall be totalized for an adjustable time period. The time period shall be defined uniquely for each Btu totalization.

#### 2.15.2.6 Trending

Any analog or calculated point shall be operator assignable to the trend program. Up to eight points shall be sampled at individually assigned intervals, selectable between one minute and two hours. A minimum of the most recent 128 samples of each trended point shall be stored. The sample intervals shall be able to be defined, modified, or deleted on-line.

#### 2.15.3 I/O Point Database/Parameter Definition

Each I/O point shall be defined in a database residing in the DDC. The definition shall include all physical parameters associated with each point. Each point shall be defined and entered into the database by the Contractor, including as applicable:

- a. Name.
- b. Device or sensor type (i.e., sensor, control relay, motors).
- c. Point identification number.
- d. Unit.
- e. Building number.
- f. Area.
- g. Island.

- h. DDC number and channel address.
- i. KW (running).
- j. KW (starting).
- k. Sensor range.
- l. Controller range.
- m. Sensor span.
- n. Controller span.
- o. Engineering units conversion (scale factor).
- p. Setpoint (analog).
- q. High reasonableness value (analog).
- r. Low reasonableness value (analog).
- s. High alarm limit differential (return to normal).
- t. Low alarm limit differential (return to normal).
- u. High alarm limit (analog).
- v. Low alarm limit (analog).
- w. Alarm disable time period upon startup or change of setpoint.
- x. Analog change differential (for reporting).
- y. Alarm class and associated primary message text.
- z. High accumulator limit (pulse).
- aa. Status description.
- bb. Run time target.
- cc. Failure mode as specified and shown.
- dd. Constraints as specified.

#### 2.15.4 Alarm Processing

Each DDC shall have alarm processing software for AI, DI, and PA alarms for all real and virtual points connected to that DDC.

##### 2.15.4.1 Digital Alarms Definition

Digital alarms are those abnormal conditions indicated by DIs as specified

and shown.

#### 2.15.4.2 Analog Alarms Definition

Analog alarms are those conditions higher or lower than a defined value, as measured by an AI. Analog readings shall be compared to predefined high and low limits, and alarmed each time a value enters or returns from a limit condition. Unique high and low limits shall be assigned to each analog point in the system. Analog alarm limits shall be stored in the DDC database. Each analog alarm limit shall have an associated unique limit differential specifying the amount by which a variable must return into the proper operating range before being annunciated as a return-to-normal-state. All limits and differentials shall be entered on-line by the operator in limits of the measured variable, without interruption or loss of monitoring of the point concerned. The program shall automatically change the high or low limits or both, of any analog point, based on time scheduled operations as specified, allowing for a time interval before the alarm limit becomes effective. In CPA applications, key the limit to a finite deviation traveling with the setpoint. The system shall automatically suppress analog alarm reporting associated with a digital point when that digital point is turned off.

#### 2.15.4.3 Pulse Accumulator Alarms Definition

Pulse accumulator alarms are those conditions calculated from totalized values of accumulator inputs or PA input rates that are outside defined limits as specified and shown. PA totalized values shall be compared to predefined limits and alarmed each time a value enters a limit condition. Unique limits shall be assigned to each PA point in the system. Limits shall be stored in the DDC database.

#### 2.15.5 Constraints

##### 2.15.5.1 Equipment Constraints Definitions

Each control point in the database shall have DDC resident constraints defined and entered by the Contractor, including as applicable:

- a. Maximum starts (cycles) per hour.
- b. Minimum off time.
- c. Minimum on time.
- d. High limit (value in engineering units).
- e. Low limit (value in engineering units).

##### 2.15.5.2 Constraints Checks

Control devices connected to the system shall have the DDC memory resident constraints checked before each command is issued to insure that no equipment damage will result from improper operation. Each command shall be executed by the DDC only after all constraints checks have been passed.

Each command point shall have unique constraints assigned. High and low "reasonableness" values or one differential "rate-of-change" value shall be assigned to each AI. Values outside the reasonableness limits shall be rejected and an alarm message sent to the network control panel or portable workstation/tester. Status changes and analog point values shall be reported to the workstation upon operator request, such as for reports, alphanumeric displays, graphic displays, and application programs. Each individual point shall be capable of being selectively disabled by the operator from a workstation/tester. Disabling a point shall prohibit monitoring and automatic control of that point.

#### 2.15.6 Diagnostics

Each DDC shall have self-test diagnostic routines implemented in firmware. The tests shall include routines that exercise memory. Diagnostic software shall be usable in conjunction with the central workstation/tester and portable workstation/tester. The software shall display messages in English to inform the tester's operator of diagnosed problems.

#### 2.15.7 Summer-Winter Operation Monitoring

The system shall provide software to automatically change the operating parameters, monitoring of alarm limits, and start-stop schedules for each mechanical system from summer to winter and vice-versa. The software shall provide automatic commands to applications programs to coordinate proper summer or winter operation. Change over setpoints shall be operator selectable and settable.

#### 2.15.8 Control Sequences and Control Loops

Sufficient memory shall be provided to implement the requirements specified and shown for each DDC. Specific functions to be implemented are defined in individual system control sequences and database tables shown in the drawings, and shall include, as applicable, the following:

a. PI Control: This function shall provide proportional control and proportional plus integral control.

b. Two Position Control: This function shall provide control for a two state device by comparing a set point against a process variable and an established deadband.

c. Floating Point Control: This function shall exercise control when an error signal exceeds a selected deadband, and shall maintain control until the error is within the deadband limits.

d. Signal Selection: This function shall allow the selection of the highest or lowest analog value from a group of analog values as the basis of control. The function shall include the ability to cascade analog values so that large numbers of inputs can be reduced to one or two outputs.

e. Signal Averaging: This function shall allow the mathematical calculation of the average analog value from a group of analog values as the basis of control. The function shall include the ability to "weight"

the individual analog values so that the function output can be biased as necessary to achieve proper control.

f. Reset Function: This function shall develop an AO based on up to two AIs and one operator specified reset schedule.

g. Cooling/Heating Operation Program: Software shall be provided to change, either automatically or on operator command, the operating parameters, monitoring of alarm limits, and start-stop schedules for each mechanical system where such a change from cooling to heating and vice versa is meaningful. The software shall provide commands to application programs to coordinate cooling or heating mode operation. Software shall automatically switch facilities from cooling to heating, and vice versa, based on schedules or temperatures. All HVAC equipment and systems shall be assigned to the program.

#### 2.15.9 Command Priorities

A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. The system shall require the latest highest priority command addressed to a single point to be stored for a period of time longer than the longest time constraint in the on and off states, insuring that the correct command shall be issued when the time constraint is no longer in effect or report the rejected command. Override commands entered by the operator shall have higher priority than those emanating from applications programs.

#### 2.15.10 Resident Application Software

The Contractor shall provide resident applications programs to achieve the sequences of operation, parameters, constraints, and interlocks necessary to provide control of the systems connected to the DDC system. Application programs shall be resident and shall execute in the DDC, and shall coordinate with each other, to insure that no conflicts or contentions remain unresolved. The Contractor shall coordinate the application programs specified with the equipment and controls operation, and other specified requirements. A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. The system shall require the latest highest priority command addressed to a single point to be stored for a period of time longer than the longest time constraint in the ON and OFF states, insuring that the correct command shall be issued when the time constraint is no longer in effect or the rejected command shall be reported. Override commands entered by the operator shall have higher priority than those emanating from application programs.

##### 2.15.10.1 Program Inputs and Outputs

The Contractor shall select the appropriate program inputs listed for each application program to calculate the required program outputs. Where the specific program inputs are not available, a "default" value or virtual point appropriate for the equipment being controlled and the proposed sequence of operation shall be provided to replace the missing input, thus allowing the application program to operate. AIs to application programs

shall have an operator adjustable deadband to preclude short cycling or hunting. Program outputs shall be real analog or digital outputs or logic (virtual) points as required to provide the specified functions. The Contractor shall select the appropriate input and output signals to satisfy the requirements for control of systems as shown.

#### 2.15.10.2 DDC General Conditions

The Contractor shall provide software required to achieve the sequences of operation, parameters, constraints, and interlocks shown. Application software shall be resident in the DDC in addition to any other required software. In the event of a DDC failure, the controlled equipment shall continue to function in the failure mode shown.

#### 2.15.10.3 Scheduled Start/Stop Program

This program shall start and stop equipment based on a time of day schedule for each day of the week, and on a holiday schedule. To eliminate power surges, an operator adjustable time delay shall be provided between consecutive start commands.

##### a. Program Inputs:

- (1) Day of week/holiday.
- (2) Time of day.
- (3) Cooling and heating high-low alarm limits.
- (4) Cooling and heating start-stop schedules.
- (5) Cooling or heating mode of operation.
- (6) Equipment status.
- (7) Equipment constraints.
- (8) Consecutive start time delay.

##### b. Program Outputs: Start/stop signal.

#### 2.15.10.4 Optimum Start/Stop Program

This program shall start and stop equipment as specified for the scheduled start/stop program, but shall include a sliding schedule based on indoor and outdoor air conditions. The program shall take into account the thermal characteristics of the structure, and indoor and outdoor air conditions, using prediction software to determine the minimum time of HVAC system operation needed to satisfy space environmental requirements at the start of the occupied cycle, and determine the earliest time for stopping equipment at the day's end without exceeding space environmental requirements. An adaptive control algorithm shall be utilized to automatically adjust the constants used in the program.

## a. Program Inputs:

- (1) Day of week/holiday.
- (2) Time of day.
- (3) Cooling or heating mode of operation.
- (4) Equipment status.
- (5) Cooling and heating building occupancy schedules.
- (6) Space temperature.
- (7) Building heating constant (operator adjustable and automatically optimized).
- (8) Building cooling constant (operator adjustable and automatically optimized).
- (9) OA temperature.
- (10) Required space temperature at occupancy (heating).
- (11) Required space temperature at occupancy (cooling).
- (12) Equipment constraints.
- (13) Cooling and heating high-low alarm limits.

## b. Program Outputs: Start/stop signal.

## 2.15.10.5 Day-Night Setback Program

The software shall limit the rise or drop of space temperature (or specified fluid temperature) during unoccupied hours. Whenever the space temperature (or specified fluid temperature) is above (or below for heating) the operator assigned temperature limit, the system shall be turned on until the temperature is within the assigned temperature limit.

## a. Program Inputs:

- (1) Day of week.
- (2) Time of day.
- (3) Cooling or heating mode of operation.
- (4) Cooling and heating occupancy schedules.
- (5) Equipment status.
- (6) Space temperature (or specified fluid temperature).

(7) Minimum space temperature (or specified fluid temperature) during unoccupied periods.

(8) Maximum space temperature (or specified fluid temperature) during unoccupied periods.

(9) Equipment constraints.

b. Program Outputs: Start/stop signal.

#### 2.15.10.6 Economizer Program I

The software shall reduce the HVAC system cooling requirements when the OA dry bulb temperature is less than the return air temperature. When the OA dry bulb temperature is above the return air temperature or changeover setpoint, the OA dampers, return air dampers, and relief air dampers shall be positioned to provide minimum required OA. When the OA dry bulb temperature is below a changeover setpoint temperature, the OA dampers, return air dampers, and exhaust air dampers shall be positioned to maintain the required mixed air temperature.

a. Program Input:

- (1) Changeover conditions.
- (2) OA dry bulb temperature.
- (3) RA dry bulb temperature.
- (4) Mixed air dry bulb temperature.
- (5) Equipment constraints.

b. Program Output: Damper actuator/cooling control signal.

#### 2.15.10.7 Ventilation/Recirculation and Flush Programs

The software shall reduce the HVAC system thermal load for two modes of operation and provide for flushing of the building as follows:

a. Ventilation mode: In this mode, the system shall precool the space prior to building occupancy. When the outside air temperature is lower than the space temperature, the outside air damper and exhaust air damper shall open to their maximum positions and the return air damper shall close to its minimum position.

b. Recirculation mode: In this mode, the system shall preheat the space prior to building occupancy. When the outside air temperature is lower than the space temperature, the outside air damper and the exhaust air damper shall close to their minimum positions and the return air damper shall open to its maximum position.

c. Flush mode: The software shall use the HVAC supply system to provide 100% outside air for ventilation purpose and flush building spaces.



The network control panel shall modulate the control valves to maintain the air supply temperature setpoints while the flush program is in effect. The flush mode shall be manually initiated and have the highest priority (it shall override all other programs). The outside air damper and the exhaust air damper shall be closed at other times during unoccupied periods, except for economizer operation during day/night setback periods. For systems without mechanical cooling, this program shall, in addition to the above requirements, act as an economizer. The outside, return, and exhaust air dampers shall be modulated to maintain the required mixed air temperature setpoint. When this program is released, the outside and exhaust air dampers shall return to their minimum positions, and the return air damper shall return to its maximum position.

d. Program Inputs:

- (1) Day of week.
- (2) Time of day.
- (3) Cooling or heating mode of operation.
- (4) Equipment status.
- (5) Cooling and heating occupancy schedules.
- (6) OA dry bulb temperature.
- (7) Space temperature.
- (8) Equipment constraints.

e. Program Output: Damper actuator control signal.

2.15.10.8 Reheat Coil Reset Program

The software shall select the zone with the least amount of heat required. The program shall reset the cold deck discharge temperature upward until it satisfies the zone with the lowest demand, or until the zone humidity control requirements cannot be met.

a. Program Inputs:

- (1) Zone RH high limit.
- (2) Zone temperature (where shown).
- (3) Zone RH (where shown).
- (4) Cold deck temperature.
- (5) Reheat coil valve positions or proportional signals from primary elements.
- (6) Minimum space temperature during occupied periods.

- (7) Maximum space temperature during occupied periods.
- (8) Equipment constraints.

b. Program Output: Cold deck valve actuator control signal.

#### 2.15.10.9 Air Volume Control Program

The software shall monitor supply and return/exhaust air flow volumes and modulate fan controls to maintain required air flow volumes and/or ratio or fixed differential of supply to return air flows. This program shall be coordinated with the ventilation-recirculation program and the economizer program for damper control and with static pressure control requirements for fan control.

a. Program Inputs

- (1) Supply air flow.
- (2) Return/exhaust air flow.
- (3) Required supply air flow - high and low limits.
- (4) Required return/exhaust air flow - high and low limits.
- (5) Volume offset or ratio, as appropriate.

b. Program Outputs

- (1) Supply fan volume control.
- (2) Return/exhaust fan volume control.

#### 2.15.10.10 Air Distribution Unitary Controller Software

Software shall be provided for the management and control of the air distribution terminal units. Software shall allow for operator definition of multiple air distribution terminal units as functional groups which may be treated as a single entity; monitoring, alarming and reporting of terminal unit parameters on an individual or group basis; and remote setpoint adjustment on an individual or group basis.

a. Functions:

- (1) Volume control in response to temperature.
- (2) Volume flow limits, minimum and maximum.
- (3) Occupied and unoccupied operation with associated temperature and volume limits.
- (4) Temperature setpoint override.

b. Program Inputs

- (1) Space temperature.
- (2) Space temperature setpoint.
- (3) Space temperature setpoint limits.
- (4) Supply airflow volume.
- (5) Supply airflow volume high and low limits.

## c. Program Outputs

- (1) Supply volume control signal.
- (2) Auxiliary fan start/stop signal.
- (3) Supplemental heat control signal.

## 2.15.10.11 Chiller Selection Program

Chiller program shall be used for chiller selection as well as control and monitoring of chillers. The software shall select the most efficient chiller or combination of chillers based on chiller operating data to satisfy the cooling load. Based on chiller operating data, energy input vs chilled water output, the chiller with the highest efficiency shall be selected to satisfy the cooling load calculated by prediction software. The program shall calculate equipment electrical energy input based on percent full load, current, or other inputs provided, and equipment nameplate data. The program shall prevent the chiller from going to full load for a predetermined period to allow the system to stabilize, in order to determine the actual cooling load. The program shall follow the chiller manufacturer's startup and shutdown sequence requirements. Interlocks between chilled water pumps, condenser water pumps, and chiller shall be in accordance with the chiller manufacturer's requirements.

## a. Program Inputs

- (1) Efficiency curves.
- (2) Chiller water supply temperatures.
- (3) Chiller water return temperatures.
- (4) Chiller water flows.
- (5) Entering condenser water temperatures.
- (6) Leaving condenser water temperatures.
- (7) Condenser water flows.
- (8) Instantaneous KW to chillers.
- (9) Instantaneous KW to chilled water pumps (if variable).
- (10) Instantaneous KW to condenser water pumps (if variable).
- (11) Instantaneous KW to cooling tower fans (if variable).
- (12) Common chilled water supply temperatures.
- (13) Common chilled water return temperatures.
- (14) Total chilled water flow.
- (15) Chilled water pumps status.
- (16) Refrigerant pressure, suction and discharge.
- (17) Equipment constraints.
- (18) Steam flow.

## b. Program Outputs

- (1) Start/stop signals for chillers (manual or automatic to control panel).
- (2) Start/stop signals for chilled water pumps (manual or automatic to control panel).
- (3) Start/stop signals for condenser water pumps (manual or automatic to control panel).
- (4) Start/stop signals for cooling tower fans (manual or automatic to control panel).

- (5) Chilled water supply temperature setpoint control signal.
- (6) Chiller efficiency.

#### 2.15.10.12 Chilled Water Temperature Reset Program

The software shall reset the chilled water temperature supplied by a water chiller. The program shall reset the chilled water temperature upward or downward to meet the required space temperature or humidity setpoints. The program shall monitor the positions of the chilled water control valves (percent of opening) and space temperatures.

##### a. Program Input:

- (1) Chilled water valve position.
- (2) High limit for space dry bulb temperature.
- (3) Chiller supply water temperature.
- (4) High chilled water operating temperature.
- (5) Low chilled water operating temperature.
- (6) High limit for space RH.
- (7) Equipment constraints.

b. Program Output: Chilled water supply temperature setpoint control signal.

#### 2.15.10.13 Chiller Demand Limit Program

The software shall limit maximum available chiller cooling capacity in fixed steps as shown to limit electrical demand. Each fixed step shall be considered as one point in the demand limiting program. Each chiller demand control step shall be assigned an equipment priority level.

##### a. Program Inputs:

- (1) Chiller percent capacity.
- (2) Minimum cooling capacity.
- (3) Equipment priority schedules.
- (4) Equipment constraints.

##### b. Program Output

- (1) Calculated percent load point.
- (2) Control signal to chiller controller/panel, new setpoint (manual or automatic as shown).

#### 2.15.10.14 Hot Water OA Reset Program

The software shall reset the hot water temperature supplied by the boiler or converter in accordance with the OA temperature or other specified independent- dent variable. The hot water supply temperature shall be reset downward or upward from a fixed temperature proportionally, as a function of OA temperature or other specified independent variable.

##### a. Program Inputs

- (1) Reset schedule.
- (2) OA dry bulb temperature or other specified independent variable.
- (3) Hot water supply temperature.
- (4) Maximum hot water supply temperature.
- (5) Minimum hot water supply temperature.
- (6) Equipment constraints.

b. Program Output: Valve actuator control signal.

#### 2.15.10.15 Hot Water Distribution Program

The software shall control the hot water distribution temperature to individual building zones. The zone hot water distribution temperature shall be reset downward or upward from a fixed temperature proportionally as a function of OA temperature or other specified independent variable by modulating the respective zone mixing valve. The zone pump shall be stopped when the OA temperature exceeds the specified setpoint. When parallel pumps are used, the software shall alternate pump operation and shall start the standby pump (after a time delay) upon failure of the operating pump.

a. Program Inputs

- (1) Zone hot water distribution temperature.
- (2) Reset schedule.
- (3) OA dry bulb temperature or other specified independent variable.
- (4) Maximum zone hot water distribution temperature.
- (5) Zone pump status.
- (6) Equipment constraints.

b. Program Outputs

- (1) Zone mixing valve control.
- (2) Zone pump start/stop signal(s).

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION CRITERIA

##### 3.1.1 HVAC Control System

The HVAC control system shall be completely installed and ready for operation. Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

### 3.1.2 Software Installation

Software shall be loaded for an operational system, including databases for all points, operational parameters, and system, command, and application software. The Contractor shall provide original and backup copies of source, excluding the general purpose operating systems and utility programs furnished by computer manufacturers and the non-job-specific proprietary code furnished by the system manufacturer, and object modules for software on each type of media utilized, within 30 days of formal Government acceptance. In addition, a copy of individual floppy disks of software for each DDC panel shall be provided.

### 3.1.3 Device Mounting Criteria

Devices mounted in or on piping or ductwork, on building surfaces, in mechanical/electrical spaces, or in occupied space ceilings shall be installed in accordance with manufacturer's recommendations and as shown. Control devices to be installed in piping and ductwork shall be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified.

### 3.1.4 Wiring Criteria

Wiring external to control panels, including low-voltage wiring, shall be installed in metallic raceways. Nonmetallic-sheathed cables or metallic-armored cables may be installed in areas permitted by NFPA 70. Wiring shall be installed without splices between control devices and DDC panels. Instrumentation grounding shall be installed as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Ground rods installed by the contractor shall be tested as specified in IEEE Std 142. Cables and conductor wires shall be tagged at both ends, with the identifier shown on the shop drawings. Electrical work shall be as specified in Section 16415A ELECTRICAL WORK, INTERIOR and as shown.

## 3.2 CONTROL SYSTEM INSTALLATION

### 3.2.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators operating a common damper shall be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

### 3.2.2 Local Gauges for Actuators

Pneumatic actuators shall have an accessible and visible receiver gauge installed in the tubing lines at the actuator as shown.

### 3.2.3 Room Instrument Mounting

Room instruments , such as wall mounted thermostats, shall be mounted 60 inches above the floor unless otherwise shown. Temperature setpoint devices shall be recess mounted.

### 3.2.4 Freezestats

For each 20 square feet of coil face area, or fraction thereof, a freezestat shall be provided to sense the temperature at the location shown. Manual reset freezestats shall be installed in approved, accessible locations where they can be reset easily. The freezestat sensing element shall be installed in a serpentine pattern.

### 3.2.5 Averaging Temperature Sensing Elements

Sensing elements shall have a total element minimum length equal to 1 linear foot per square foot of duct cross-sectional area.

### 3.2.6 Foundations and Housekeeping Pads

Foundations and housekeeping pads shall be provided for the HVAC control system air compressors.

### 3.2.7 Compressed Air Stations

The air compressor assembly shall be mounted on vibration eliminators, in accordance with ASME BPVC SEC VIII D1 for tank clearance. The air line shall be connected to the tank with a flexible pipe connector. Compressed air station specialties shall be installed with required tubing, including condensate tubing to a floor drain.

### 3.2.8 Duct Static Pressure Sensing Elements and Transmitters

The duct static pressure sensing element and transmitter sensing point shall be located at 75% to 100% of the distance between the first and last air terminal units.

### 3.2.9 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Gauges for steam service shall have pigtail fittings with cock. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

### 3.2.10 Tubing

#### 3.2.10.1 Control System Installation

The control system shall be installed so that pneumatic lines are not exposed to outside air temperatures. All tubes and tube bundles exposed to view shall be installed neatly in lines parallel to the lines of the building. Tubing between panels and actuators in mechanical/electrical spaces shall be routed so that the lines are easily traceable.

### 3.2.10.2 Pneumatic Lines In Mechanical/Electrical Spaces

In mechanical/electrical spaces, pneumatic lines shall be plastic tubing or copper tubing. Horizontal and vertical runs of plastic tubes or soft copper tubes shall be installed in raceways dedicated to tubing. Dedicated raceways and tubing not installed in raceways shall be supported every 6 feet for horizontal runs and every 8 feet for vertical runs.

### 3.2.10.3 Pneumatic Lines External To Mechanical/Electrical Spaces

Tubing external to mechanical/electrical spaces, when run in plenum ceilings, shall be soft copper with sweat fittings. Tubing not in plenum spaces shall be soft copper with sweat fittings or shall be plastic tubing in raceways dedicated to tubing. Raceways and tubing not in raceways shall be supported every 8 feet.

### 3.2.10.4 Connection to Liquid and Steam Lines

Tubing for connection of sensing elements and transmitters to liquid and steam lines shall be Series 300 stainless steel with stainless-steel compression fittings.

### 3.2.10.5 Connection to Ductwork

Tubing for connection of sensing elements and transmitters to ductwork shall be plastic tubing.

### 3.2.10.6 Tubing in Concrete

Tubing in concrete shall be installed in rigid conduit. Tubing in walls containing insulation, fill, or other packing materials shall be installed in raceways dedicated to tubing.

### 3.2.10.7 Final Connection to Actuators

Final connections to actuators shall be plastic tubing 12 inches long and unsupported at the actuator.

## 3.3 CONTROL SEQUENCES OF OPERATION

### 3.3.1 General Requirements - HVAC Systems

These requirements shall apply to all primary HVAC systems unless modified herein. The sequences describe the actions of the control system for one direction of change in the HVAC process analog variable, such as temperature, humidity or pressure. The reverse sequence shall occur when the direction of change is reversed.

#### 3.3.1.1 Supply Fan Operating

HVAC system outside air, return air, and relief air dampers shall function as described for specific modes of operation unless control of the dampers is assumed by the fire and smoke control system. Smoke dampers shall open



before fans are allowed to start. Interlocked exhaust fans shall be stopped in the unoccupied and ventilation delay modes and their dampers shall be closed. Interlocked exhaust fans shall run in the occupied mode, and their dampers shall open. Cooling coil control valves and cooling coil circulating pumps shall function as described for the specific modes of operation unless their control is assumed by the freeze protection system. Heating coil valves shall be under control.

#### 3.3.1.2 Supply Fan Not Operating

When an HVAC system is stopped, all interlocked fans shall stop, the smoke dampers shall close, the outside air and relief air dampers shall close, the return air damper shall open, all stages of direct-expansion cooling shall stop, the system shall pump down if it has a pump down cycle, humidification shall stop, and cooling coil valves for coils located indoors shall close to the coil. Cooling coil valves of units located outdoors shall open to the coil. Heating coil valves shall remain under control.

#### 3.3.1.3 Hydronic Heating - Distribution Pump Operating

Hydronic heat-exchanger valves shall be under control.

#### 3.3.1.4 Hydronic Heating - Distribution Pump Not Operating

Hydronic heat-exchanger valves shall close.

#### 3.3.2 Perimeter Radiation Control Sequence

All Modes - A room thermostat, located as shown, shall operate a control valve to maintain the setpoint as shown.

#### 3.3.3 Unit Heater and Cabinet Unit Heater

All Modes - A wall-mounted thermostat with an "AUTO-OFF" switch located as shown, shall cycle the fan to maintain its setpoint as shown when the switch is in the "AUTO" position. When the switch is in the "OFF" position, the fan shall be stopped.

#### 3.3.4 Gas-Fired Infrared Heater

A microprocessor-based room thermostat with "AUTO-OFF" switch, located as shown, shall control the infrared heater. Auto Mode - When the switch is in the "AUTO" position, the thermostat shall cycle the infrared heater to maintain the day and night setpoints. Programmed occupied times shall be considered "day" and programmed unoccupied times shall be considered "night." Off Mode - When the switch is in the "OFF" position, the infrared heater shall be off.

#### 3.3.5 All-Air Small Package Unitary System

A microprocessor-based room thermostat, located as shown, with "HEAT-OFF-COOL" and "AUTO-ON" switches shall control the system. Heating Mode - Cooling unit shall be off, and heating shall be active. The

thermostat shall operate the condensing unit and system fan to maintain the day and night setpoints as shown. Programmed occupied times shall be considered "day" and programmed unoccupied times shall be considered "night." Cooling Mode - Heating unit shall be off. During the day the thermostat shall operate the condensing units and system fan to maintain the setpoint. The condensing unit shall be off at night. Off Mode - The system shall be off. On Mode - The system fan shall run continuously. Auto Mode - The system fan shall operate whenever heating or cooling is required.

### 3.3.6 Dual Temperature Fan-Coil Unit

All Modes - A wall-mounted thermostat, located as shown, shall cycle the fan to maintain the setpoint as shown. When the fan is on, a 3-way valve shall open to the coil. When the fan is off, the 3-way valve shall bypass the coil. An aquastat shall switch the wall-mounted thermostat action from heating mode to cooling mode whenever the hydronic dual-temperature medium is below the setpoint.

### 3.3.7 Central Plant Hydronic Heating with Steam/Hot Water Converter

#### 3.3.7.1 All Modes

The DDC system shall accept a signal from a sunshielded outside air temperature sensing element and transmitter located as shown. The DDC system shall start and stop pump at the outside air temperatures shown. The DDC system shall reset the hydronic heating supply temperature setpoint in a linear schedule based on the outside air temperature as shown. The DDC system shall accept a signal from a temperature sensing element and transmitter located in the hydronic heating supply line and the DDC system output shall modulate the converter steam control valve to maintain the reset schedule setpoint in the hydronic heating supply line.

#### 3.3.7.2 Occupied Mode

When the system time schedule places the system in the occupied mode, a space temperature sensing element and transmitter located as shown shall signal the DDC system, which shall maintain the space temperature setpoint by modulating the secondary hydronic system zone valve.

#### 3.3.7.3 Unoccupied Mode

When the system is in the unoccupied mode, the space temperature setpoint shall be as shown.

### 3.3.8 Single Zone with Hydronic Heating/Cooling Coils No Return Fan

#### 3.3.8.1 Occupied, Unoccupied, and Ventilation Delay Modes of Operation

Ventilation delay mode timing shall start prior to the occupied mode timing. The DDC system shall prevent the outside air damper from opening. At the time shown, the DDC system shall place the system in the occupied mode. At the expiration of the ventilation delay mode timing period, the DDC system shall allow the outside air damper to open. At the time shown,

the DDC system shall place the control system in the unoccupied mode of operation.

#### 3.3.8.2 Outside Air, Return Air, and Relief Air Dampers

a. Occupied Mode - The outside air, return air, and relief air dampers shall be under space temperature and economizer control.

b. Unoccupied Mode - The dampers shall return to their normal positions.

c. Ventilation Delay Mode - The dampers shall return to their normal positions, except when under economizer control.

#### 3.3.8.3 Supply Fan Control

a. Occupied and Ventilation Delay Modes - Supply fan shall start, and shall operate continuously.

b. Unoccupied Mode - The supply fan shall cycle according to the night setback schedule. The fan shall start and stop at the setpoints.

#### 3.3.8.4 Filter

A differential pressure switch across the filter shall initiate a filter alarm when the pressure drop across the filter reaches the setpoint.

#### 3.3.8.5 Freeze Protection

All Modes - A freezestat, located as shown, shall stop the supply fan, cause the outside air, return air, and relief air dampers to return to their normal position, and shall initiate a low temperature alarm if the temperature drops below the freezestat's setpoint. Return to the normal mode of operation shall require manual reset at the freezestat. The DDC system shall monitor the freezestat through auxiliary contacts and shall indicate an alarm condition when the freezestat trips.

#### 3.3.8.6 Hydronic Cooling Coil

a. Occupied and Ventilation Delay Modes - The control valve shall be modulated by the DDC system from the signal of a space temperature sensor.

b. Unoccupied Mode - The DDC system shall close the cooling coil control valve.

#### 3.3.8.7 Economizer Control

The DDC system shall accept the signal of an outside air temperature sensing element and transmitter and the signal of a return air temperature sensing element and transmitter. The DDC system shall perform switchover between outside air economizer control mode and minimum outside air mode. Until the return air temperature rises above the setpoint, the DDC system shall hold the system in the minimum outside air mode. When the return air temperature rises above the setpoint, the DDC system shall place the AHU in

the economizer mode or in the minimum outside air mode, as determined by a comparison of the outside air and return air temperatures in accordance with the differential temperature setpoints. When the outside air temperature is low with respect to the return air temperature, the AHU shall be in the economizer mode. When the DDC system places the control system in the minimum outside air mode, the outside air damper shall be open to the minimum outdoor air setting.

#### 3.3.8.8 Space Temperature Sequenced Heating and Cooling Control

When the DDC system is in the economizer mode, it shall maintain the setpoint from the signal of a space temperature sensor and transmitter. On a rise in space temperature, the DDC system shall first gradually close the heating coil valve. After passing through a deadband, the DDC system shall gradually operate the outside air damper to admit outside air beyond the minimum quantity and after the outside air damper is fully open the DDC system shall then operate the cooling coil valve to maintain the setpoint. When the DDC system is in the minimum outside air mode, the outside air damper shall be open to the minimum outside air setting. On a rise in space temperature, the DDC system shall first gradually close the heating coil valve. After passing through a deadband, the DDC system shall then gradually open the cooling coil valve to maintain the setpoint.

#### 3.3.8.9 Emergency Fan Shutdown

All Modes - Smoke detectors in the supply air and return air ductwork shall stop the supply fan and initiate a smoke alarm if smoke is detected at either location. Restarting the supply fan shall require manual reset at the smoke detector.

### 3.4 COMMISSIONING PROCEDURES

#### 3.4.1 Evaluations

The Contractor shall make the observations, adjustments, calibrations, measurements, and tests of the control systems, set the time schedule, and make any necessary control system corrections to ensure that the systems function as described in the sequence of operation.

##### 3.4.1.1 Item Check

Signal levels shall be recorded for the extreme positions of each controlled device. An item-by-item check of the sequence of operation requirements shall be performed using Steps 1 through 4 in the specified control system commissioning procedures. Steps 1, 2, and 3 shall be performed with the HVAC system shut down; Step 4 shall be performed after the HVAC systems have been started. External input signals to the DDC system (such as starter auxiliary contacts, and external systems) may be simulated in steps 1, 2, and 3. With each operational mode signal change, DDC system output relay contacts shall be observed to ensure that they function.

#### 3.4.1.2 Weather Dependent Test Procedures

Weather dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the actual results shall be verified in the appropriate season.

#### 3.4.1.3 Two-Point Accuracy Check

A two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter shall be performed by comparing the DDC system readout to the actual value of the variable measured at the sensing element and transmitter or airflow measurement station location. Digital indicating test instruments shall be used, such as digital thermometers, motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensing element-to-DDC system readout accuracy. The calibration of the test instruments shall be traceable to National Institute Of Standards And Technology standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-DDC system readout accuracies at two points are within the specified product accuracy tolerances. If not, the device shall be recalibrated or replaced and the calibration check repeated.

#### 3.4.1.4 Insertion and Immersion Temperatures

Insertion temperature and immersion temperature sensing elements and transmitter-to-DDC system readout calibration accuracy shall be checked at one physical location along the axis of the sensing element.

#### 3.4.1.5 Averaging Temperature

Averaging temperature sensing element and transmitter-to-DDC system readout calibration accuracy shall be checked every 2 feet along the axis of the sensing element in the proximity of the sensing element, for a maximum of 10 readings. These readings shall then be averaged.

#### 3.4.2 Space Temperature Controlled Perimeter Radiation

The heating medium shall be turned on, and the thermostat temperature setpoint shall be raised. The valve shall open. The thermostat temperature shall be lowered and the valve shall close. The thermostat shall be set at the setpoint shown.

#### 3.4.3 Unit Heater and Cabinet Unit Heater

The "OFF/AUTO" switch shall be placed in the "OFF" position. Each space thermostat temperature setting shall be turned up so that it makes contact to turn on the unit heater fans. The unit heater fans shall not start. The "OFF/AUTO" switch shall be placed in the "AUTO" position. It shall be ensured that the unit heater fans start. Each space thermostat temperature setting shall be turned down, and the unit heater fans shall stop. The thermostats shall be set at their temperature setpoints. The results of testing of one of each type of unit shall be logged.

#### 3.4.4 All-Air Small Packaged Unitary

The schedules shall be manually entered for day temperature and night temperature setpoints as shown. The fan "AUTO/ON" switch shall be set to "ON." The time shall be manually entered as "DAY." The "HEATING/COOLING" switch shall be set to "HEATING" and it shall be ensured that cooling is off. The temperature setpoint shall be raised and it shall be ensured that heating starts. The "HEATING/COOLING" switch shall be set to "COOLING" and it shall be ensured that heat is off. The temperature setpoint shall be lowered and it shall be ensured that cooling starts. The fan "AUTO/ON" switch shall be set to "AUTO" and the foregoing procedure repeated. The fan shall start and stop automatically with the starting and stopping of heating and cooling. The time shall be manually entered as "NIGHT." The foregoing procedures shall be repeated. When the system is verified as operational, the correct "DAY" and "NIGHT" temperature settings shall be restored and the correct time restored. The power to the thermostat shall be shut off and it shall be verified that the thermostat clock keeps time. The results of testing of one of each type of unit shall be logged.

#### 3.4.5 Fan Coil Unit

The dual-temperature hydronic system shall be set to heating. Each space thermostat temperature setting shall be turned up so that it makes contact and turns the fan coil unit on. It shall be ensured that the fan coil unit fan starts and the valves open to flow through the coils. Each space thermostat temperature setting shall be turned down and it shall be ensured that the fan coil unit fans stop. It shall be ensured that the valves close to flow through the coils. The dual-temperature hydronic system shall be switched to cooling. Each space thermostat temperature setting shall be turned up and it shall be ensured that contact is broken and the fan coil unit fans stop. It shall be ensured that the valves close to flow through the coil. Each space thermostat temperature setting shall be turned down. It shall be ensured that the fan coil unit fans start and the valves open to flow through the coils. The thermostats shall be set at their temperature setpoints. The results of testing of one of each type of unit shall be logged.

#### 3.4.6 Central Plant Hydronic Heating with Steam/Hot Water Converter

Installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be observed in its shutdown condition. Power and main air shall be available where required. The converter valve shall be closed.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing element location. Each temperature shall be read at the DDC controller, and the thermometer and DDC system readings logged. The calibration accuracy of the sensing element-to-DDC system readout for outside air temperature and hydronic system supply temperature shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator, through an operator entered value to the DDC system. The proper operation of the actuators and positions for all valves shall be verified. The signal shall be varied from live zero to full range, and it shall be verified that the actuators travel from zero stroke to full stroke within the signal range. It shall be verified that all sequenced actuators move from zero stroke to full stroke in the proper direction and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control System Commissioning:

(1) The two-point calibration sensing element-to-DDC system readout accuracy check for the outside air temperature shall be performed. Any necessary software adjustments to setpoints or parameters shall be made to achieve the outside air temperature schedule.

(2) A signal shall be applied to simulate that the outside air temperature is above the setpoint. It shall be verified that pump stops. A signal shall be applied to simulate that the outside air temperature is below the setpoint. It shall be verified that pump starts.

(3) The two-point calibration accuracy check of the sensing element-to-DDC system readout for the system supply temperature shall be performed. The system supply temperature setpoint shall be set for the temperature schedule as shown. Signals of 8 ma and 16 ma shall be sent to the DDC system from the outside air temperature sensor, to verify that the supply temperature setpoint changes to the appropriate values.

(4) The control system shall be placed in the occupied mode. The calibration accuracy check of sensing element-to-DDC system readout shall be performed for each space temperature sensor and the values logged. Each space temperature setpoint shall be set as shown. The control system shall be placed in the unoccupied mode, and it shall be verified that each space temperature setpoint changes to the unoccupied mode setting.

3.4.7 Single Zone with Hydronic Heating and Cooling Coils; No Return Fan

Steps for installation shall be as follows:

a. Step 1 - System Inspection: The HVAC system shall be verified in its shutdown condition. The system shall be checked to see that power and main air are available where required, that the outside air damper, relief air damper, and cooling coil valve are closed, and that the return air damper is open.

b. Step 2 - Calibration Accuracy Check with HVAC System Shutdown: Readings shall be taken with a digital thermometer at each temperature sensing element location. Each temperature shall be read at the DDC controller, and the thermometer and DDC system display readings logged.

The calibration accuracy of the sensing element-to-DDC system readout for outside air, return air, and space temperatures shall be checked.

c. Step 3 - Actuator Range Adjustments: A signal shall be applied to the actuator through an operator entered value to the DDC system. The proper operation of the actuators and positioners for all dampers and valves shall be visually verified. The signal shall be varied from live zero to full range, and the actuator travel from zero stroke to full stroke within the signal range shall be verified. It shall be verified that all sequenced and parallel-operated actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other.

d. Step 4 - Control System Commissioning:

(1) With the fan ready to start, the control system shall be placed in the ventilation delay mode and in the occupied mode, and it shall be verified that supply fan starts. It shall be verified that the outside air and relief air dampers are closed, the return air damper is open, and the heating coil and cooling coil valves are under control, by simulating a change in the space temperature through an operator entered value. The control system shall be placed out of the ventilation delay mode, and it shall be verified that the outside air, return air, and relief air dampers come under control by simulating a change in the space temperature.

(2) The control system shall be placed in the minimum outside air mode. It shall be verified that the outside air damper opens to minimum position.

(3) The economizer mode shall be simulated by a change in the outside air temperature and the return air temperature through operator entered values and it shall be verified that the system goes into the economizer mode. The space temperature shall be artificially changed through operator entered values to slightly open the outside air damper and the second point of the two-point calibration accuracy check of sensing element-to-DDC system readout for outside air, return air, and space temperatures shall be performed. The space temperature setpoint shall be set as shown.

(4) An unoccupied mode signal shall be applied, and it shall be verified that the HVAC system shuts down, and the control system assumes the specified shutdown conditions. The space temperature shall be artificially changed to below the night setback temperature setpoint, and it shall be verified that the HVAC system starts; the space temperature shall be set to above the night setback setpoint, and it shall be verified that the HVAC system stops. The night setback temperature setpoint shall be set at the setpoint as shown.

(5) With the HVAC system running, a filter differential pressure switch input signal shall be simulated at the device. It shall be verified that the filter alarm is initiated. The differential



pressure switch shall be set at the setpoint.

(6) With the HVAC system running, a freezestat trip input signal shall be simulated at the device. HVAC system shutdown shall be verified. It shall be verified that a low temperature alarm is initiated. The freezestat shall be set at the setpoint. The HVAC system shall be restarted by manual restart and it shall be verified that the alarm returns to normal.

(7) With the HVAC system running, a smoke detector trip input signal at each detector shall be simulated, and control device actions and interlock functions as described in the Sequence of Operation shall be verified. Simulation shall be performed without false-alarms any Life Safety systems. It shall be verified that the HVAC system shuts down and that the smoke detector alarm is initiated. The detectors shall be reset. The HVAC system shall be restarted by manual reset, and it shall be verified that the alarm returns to normal.

### 3.5 BALANCING, COMMISSIONING, AND TESTING

#### 3.5.1 Coordination with HVAC System Balancing

Commissioning of the control system, except for tuning of controllers, shall be performed prior to or simultaneous with HVAC system balancing. The contractor shall tune the HVAC control system after all air system and hydronic system balancing has been completed, minimum damper positions set and a report has been issued.

#### 3.5.2 Control System Calibration, Adjustments, and Commissioning

Control system commissioning shall be performed for each HVAC system, using test plans and procedures previously approved by the Government. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform commissioning and testing of the HVAC control system. All instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Wiring shall be tested for continuity and for ground, open, and short circuits. Tubing systems shall be tested for leaks. Mechanical control devices shall be adjusted to operate as specified. HVAC control panels shall be pretested off-site as a functioning assembly ready for field connections, calibration, adjustment, and commissioning of the operational HVAC control system. Control parameters and logic (virtual) points including control loop setpoints, gain constants, and integral constraints, shall be adjusted before the system is placed on line. Communications requirements shall be as indicated. Written notification of any planned commissioning or testing of the HVAC Control systems shall be given to the Government at least 14 calendar days in advance.

#### 3.5.3 Performance Verification Test

The Contractor shall demonstrate compliance of the HVAC control system with the contract documents. Using test plans and procedures previously

approved by the Government, the Contractor shall demonstrate all physical and functional requirements of the project. The performance verification test shall show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. The performance verification test shall not be started until after receipt by the Contractor of written permission by the Government, based on Government approval of the Commissioning Report and completion of balancing. The tests shall not be conducted during scheduled seasonal off periods of base heating and cooling systems.

#### 3.5.4 Endurance Test

The endurance test shall be used to demonstrate the specified overall system reliability requirement of the completed system. The endurance test shall not be started until the Government notifies the Contractor in writing that the performance verification test is satisfactorily completed.

The Government may terminate the testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to acceptance of the system.

a. Phase I (Testing). The test shall be conducted 24 hours per day, 7 days per week, for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing.

b. Phase II (Assessment). After the conclusion of Phase I, the Contractor shall identify failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the jobsite to present the results and recommendations to the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and test review meeting, the Government may require that the Phase I test be totally or partially rerun. After the conclusion of any retesting which the Government may require, the Phase II assessment shall be repeated as if Phase I had just been completed.

#### 3.5.5 Posted and Panel Instructions

Posted and Panel Instructions, showing the final installed conditions, shall be provided for each system. The posted instructions shall consist of laminated half-size drawings and shall include the control system schematic, equipment schedule, sequence of operation, wiring diagram, communication network diagram, and valve and damper schedules. The posted instructions shall be permanently affixed, by mechanical means, to a wall near the control panel. Panel instructions shall consist of laminated

letter-size sheets and shall include a Routine Maintenance Checklist and as-built configuration check sheets. Panel instructions and one copy of the Operation and Maintenance Manuals, previously described herein, shall be placed inside each control panel or permanently affixed, by mechanical means, to a wall near the panel.

### 3.6 TRAINING

#### 3.6.1 Training Course Requirements

A training course shall be conducted for 6 operating staff members designated by the Contracting Officer in the maintenance and operation of the system, including specified hardware and software. The training period, for a total of 32 hours of normal working time, shall be conducted within 30 days after successful completion of the performance verification test. The training course shall be conducted at the project site. Audiovisual equipment and 6 sets of all other training materials and supplies shall be provided. A training day is defined as 8 hours of classroom instruction, including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

#### 3.6.2 Training Course Content

For guidance in planning the required instruction, the Contractor shall assume that attendees will have a high school education or equivalent, and are familiar with HVAC systems. The training course shall cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each HVAC control panel, the layout of one of each type of unitary equipment and the locations of each, the location of each control device external to the panels, the location of the compressed air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. The results of the performance verification test and the calibration, adjustment and commissioning report shall be presented as benchmarks of HVAC control system performance by which to measure operation and maintenance effectiveness.

-- End of Section --

SECTION 15990A

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS  
06/03

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (2002) National Standards for Total System Balance

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB TABES (1998) Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVACTAB (2002) HVAC Systems - Testing, Adjusting and Balancing

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

Three copies of the TAB Schematic Drawings and Report Forms, no later than 21 days prior to the start of TAB field measurements.

SD-03 Product Data

TAB Related HVAC Submittals;

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB Specialist.

TAB Procedures; G

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration;

List of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

Systems Readiness Check;

Proposed date and time to begin the Systems Readiness Check, no later than 7 days prior to the start of the Systems Readiness Check.

TAB Execution; G

Proposed date and time to begin field measurements, making adjustments, etc., for the TAB Report, submitted with the Systems Readiness Check Report.

TAB Verification; G

Proposed date and time to begin the TAB Verification, submitted with the TAB Report.

SD-06 Test Reports

Design Review Report; G

A copy of the Design Review Report, no later than 14 days after approval of the TAB Firm and the TAB Specialist.

Systems Readiness Check; G

A copy of completed checklists for each system, each signed by the TAB Specialist, at least 7 days prior to the start of TAB Execution. All items in the Systems Readiness Check Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Report; G

Three copies of the completed TAB Reports, no later than 7 days after the execution of TAB. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the

Professional Society or National Association used as the TAB Standard.

TAB Verification Report; G

Three copies of the completed TAB Verification Report, no later than 7 days after the execution of TAB Verification. All items in the TAB Verification Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

#### SD-07 Certificates

Ductwork Leak Testing,

A written statement signed by the TAB Specialist certifying that the TAB Specialist witnessed the Ductwork Leak Testing, it was successfully completed, and that there are no known deficiencies related to the ductwork installation that will prevent TAB from producing satisfactory results.

TAB Firm; G

Certification of the proposed TAB Firm's qualifications by either AABC, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC, NEBB or TABB against the proposed TAB Firm shall be described in detail.

TAB Specialist; G

Certification of the proposed TAB Specialist's qualifications by either AABC, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC, NEBB, or TABB against the proposed TAB Specialist shall be described in detail.

#### 1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

## SIMILAR TERMS

Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.	SMACNA's Procedures
TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.	Field Readiness Check & Prelim. Field Procedures

## 1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB TABES, or SMACNA HVACTAB unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

## 1.5 QUALIFICATIONS

## 1.5.1 TAB Firm

The TAB Firm shall be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including TAB of environmental systems, building systems commissioning, and the measuring of sound and vibration in environmental systems. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting

Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor. These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm shall be a subcontractor of the prime Contractor and shall be financially and corporately independent of the mechanical subcontractor, and shall report to and be paid by the prime Contractor.

#### 1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC, an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

#### 1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist. The TAB Specialist shall participate in the commissioning process specified in Section 15995A COMMISSIONING OF HVAC SYSTEMS.

#### PART 2 PRODUCTS (Not Applicable)

#### PART 3 EXECUTION

##### 3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

##### 3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a



letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

### 3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

### 3.4 DUCTWORK LEAK TESTING

The TAB Specialist shall witness the Ductwork Leak Testing specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and approve the results as specified in Paragraph TAB RELATED HVAC SUBMITTALS.

### 3.5 TESTING, ADJUSTING, AND BALANCING

#### 3.5.1 TAB Procedures

Step by step procedures for each measurement required during TAB Execution shall be provided. The procedures shall be oriented such that there is a separate section for each system. The procedures shall include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, kitchen hoods, fume hoods, relief vents, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

#### 3.5.2 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including installation of ceilings, walls, windows, doors, and partitions, are complete to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist shall also verify that all items such as ductwork and piping ports, terminals, connections, etc., necessary to perform TAB shall be complete during the Systems Readiness Check.

#### 3.5.3 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for

each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation to the Contracting Officer.

#### 3.5.4 TAB Verification

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a TAB Verification Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. The TAB Specialist shall update the original TAB report to reflect any changes or differences noted in the TAB verification report and submit the updated TAB report. If over 20 percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

#### 3.5.5 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

#### 3.5.6 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

-- End of Section --

## SECTION 16050N

BASIC ELECTRICAL MATERIALS AND METHODS  
02/03

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709 (2001) Laminated Thermosetting Materials

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 100 (2000) Dictionary of Electrical and Electronics Terms (IEEE)

IEEE C2 (2002) National Electrical Safety Code (IEEE)

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA C57.12.28 (1999) Pad-Mounted Equipment - Enclosure Integrity

NEMA ICS 6 (1993; R 2001) Industrial Control and Systems Enclosures

NEMA MG 1 (1998; R 2002) Motors and Generators

NEMA MG 10 (2001) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors

NEMA MG 11 (1977; R 2001) Energy Management Guide for Selection and Use of Single-Phase Motors

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA) / ELECTRONIC  
INDUSTRIES ASSOCIATION (EIA)

TIA/EIA-606-A (2002) Administration Standard for the  
Telecommunications Infrastructure  
(ANSI/TIA/EIA-606-A)

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 2, "Site Construction," Division 11, "Equipment," Division 13, "Special Construction," and Division 14, "Conveying Systems" and Division 15, "Mechanical". This section applies to all sections of Division 16, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be as indicated.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

Submittals required in the sections which refer to this section must also conform to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will

be returned without approval.

#### 1.5.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

#### 1.5.2 Drawings

Submit drawings a minimum of 14 by 20 inches in size using a minimum scale of 1/8 inch per foot, except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

#### 1.5.3 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

#### 1.5.4 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

#### 1.5.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

#### 1.5.4.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

#### 1.5.5 Operation and Maintenance Manuals

Comply with the requirements of Section 01781, "Operation and Maintenance Data" and the technical sections.

##### 1.5.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

#### 1.6 QUALITY ASSURANCE

##### 1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

##### 1.6.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

##### 1.6.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is

furnished.

#### 1.6.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

#### 1.6.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

#### 1.6.6 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

#### 1.6.7 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

### 1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

## 1.8 NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position.

Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Provide red laminated plastic label with white center core where indicated. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

## 1.9 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including pad-mounted transformers and pad-mounted switches.

- a. When the enclosure integrity of such equipment is specified to be in accordance with NEMA C57.12.28, such as for pad-mounted transformers and pad-mounted switches, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPS0710D72 or approved equal.

## 1.10 Cable Tags for Medium Voltage Cables

Provide tags of polyethylene that have an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 175 pounds. The cable tags shall have black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

## 1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

### 1.11.1 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring



connecting such centers, assemblies, or other power sources to equipment under Section 16402N, "Interior Distribution System." Power wiring and conduit shall conform to Section 16415A, "Electrical Work - Interior." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

#### 1.11.2 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, or integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 16, except internal wiring for components of packaged equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

#### 1.11.3 Three-Phase Motor Protection

Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

#### 1.12 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

#### 1.13 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

#### PART 2 PRODUCTS

Not used.

### PART 3 EXECUTION

#### 3.1 PAINTING OF EQUIPMENT

##### 3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical sections.

##### 3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09900, "Paints and Coatings".

#### 3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

#### 3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

#### 3.4 CABLE TAG INSTALLATION

Install cable tags in each switch cubicle as specified, including each splice. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring.

-- End of Section --

## SECTION 16264A

DIESEL-GENERATOR SET, STATIONARY 15-300 KW, STANDBY APPLICATIONS  
**06/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |             |  |
|-------------|--|
| ANSI C12.11 | (1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV) |
| ANSI C39.1  | (1981; R 1992) Requirements for Electrical Analog Indicating Instruments   |

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |                   |  |
|-------------------|--|
| ASTM A 53/A 53M   | (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless                              |
| ASTM A 106        | (1999e1) Seamless Carbon Steel Pipe for High-Temperature Service   |
| ASTM A 135        | (1997c) Electric-Resistance-Welded Steel Pipe  |
| ASTM A 181/A 181M | (2000) Carbon Steel Forgings for General-Purpose Piping  |
| ASTM A 234/A 234M | (2000) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service |
| ASTM B 395/B 395M | (1995) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes                        |
| ASTM B 395M       | (1995) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes (Metric)               |
| ASTM D 975        | (1998b) Diesel Fuel Oils   |

## ASME INTERNATIONAL (ASME)

- |            |   |
|------------|---|
| ASME B16.3 | (1998) Malleable Iron Threaded Fittings |
|------------|---|

ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1998) Power Piping
ASME BPVC SEC VIII D1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPVC SEC IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

## ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994; CS5a-1995) Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

## ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

EGSA 101P	(1995a) Engine Driven Generator Sets
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## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE Std 1	(1986; R 1992) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation
IEEE Std 48	(1998) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 120	(1989) Electrical Measurements in Power Circuits

IEEE Std 404 (1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V

IEEE Std 519 (1992) Harmonic Control in Electrical Power Systems

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-69 (1996) Pipe Hangers and Supports - Selection and Application

MSS SP-80 (1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1 (1993) Molded Case Circuit Breakers and Molded Case Switches

NEMA ICS 2 (1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC

NEMA ICS 6 (1993) Industrial Control and Systems, Enclosures

NEMA WC 74 (2000) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NEMA MG 1 (1998) Motors and Generators

NEMA PB 1 (1995) Panelboards

NEMA SG 3 (1995) Power Switching Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30 (1996; Errata TIA 96-2) Flammable and Combustible Liquids Code

NFPA 37 (1998) Installation and Use of Stationary Combustion Engines and Gas Turbines

NFPA 70 (2002) National Electrical Code

NFPA 99	(1999) Health Care Facilities
NFPA 110	(1999) Emergency and Standby Power Systems
SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)	
SAE ARP892	(1965; R 1994) D-C Starter-Generator, Engine
SAE J537	(1996) Storage Batteries
UNDERWRITERS LABORATORIES (UL)	
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 1236	(1994; Rev thru Mar 1999) Battery Chargers for Charging Engine-Starter Batteries

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Layout; G,

Drawings; G,

a. Base-mounted equipment, complete with base and attachments including anchor bolt template and recommended clearances for maintenance and operation.

b. Starting system.

c. Fuel system.

d. Cooling system.

e. Exhaust system.

f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.

- g. Lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, electric heater, controls and wiring.
- h. Location, type, and description of vibration isolation devices.
- i. The safety system, including wiring schematics.
- j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and all instrumentation.
- k. Panel layouts.
- l. Mounting and support for each panel and major piece of electrical equipment.
- m. Engine-generator set rigging points and lifting instructions.

Acceptance; G

Drawings which accurately depict the as-built configuration of the installation, upon acceptance of the diesel-generator set installation. Layout drawings shall be revised to reflect the as-built conditions and submitted with the as-built drawings.

SD-03 Product Data

Performance Tests;

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Sound Limitations; G

Sound power level data for the packaged unit operating at 100% load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification.

Generator;

Each generator KW rating and short circuit capacity (both symmetric and asymmetric).

Integral Main Fuel Storage Tank;

Power Factor;

Generator capability curve showing generator kVA output (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

Time-Delay on Alarms;

The magnitude of monitored values which define alarm or action setpoints, and the tolerance (plus and/or minus) at which the device activates the alarm or action.

Cooling System;

- a. The maximum and minimum allowable inlet temperatures of the coolant fluid.
- b. The maximum allowable temperature rise in the coolant fluid through the engine.
- c. The minimum allowable inlet fuel temperature.

Manufacturer's Catalog;

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate specification compliance.

Vibration Isolation;

Vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

Instructions; G

Instructions including: the manufacturer's pre-start checklist and precautions; startup procedures for test mode, manual-start mode, and automatic-start mode, (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches). Instructions shall be weatherproof, laminated in plastic, framed, and posted where directed. Posted data shall include wiring and control diagrams showing the key mechanical and electrical control elements, and a diagrammatic layout of the system.

Experience;

Statement showing that each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel-engine generator sets for commercial and industrial use.

Statement showing that the engine-generator set manufacturer/assembler has a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.



Field Engineer;

A letter listing the qualifications, schools, formal training, and experience of the field engineer.

General Installation;

A complete copy of the manufacturer's installation procedures. A detailed description of the manufacturer's recommended break-in procedure.

Site Visit;

A site visit letter stating the date the site was visited and listing discrepancies found.

SD-06 Test Reports

Onsite Inspection and Tests; G

a. A letter giving notice of the proposed dates of all onsite inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the Contractor's proposed procedures for onsite tests including the test including the test plan and a listing of equipment necessary to perform the tests. Submission shall be at least 10 days prior to beginning tests.

c. Six copies of the onsite test data described below in 8-1/2 x 11 inch 3-ring binders with a separate section for each test. Sections shall be separated by dividers with tabs. Data plots shall be full size 8-1/2 x 11 inches minimum), showing all grid lines, with full resolution.

- (1) A description of the procedures for onsite tests.
- (2) A list of equipment used, with calibration certifications.
- (3) A copy of measurements taken, with required plots and graphs.
- (4) The date of testing.
- (5) The parameters verified.
- (6) The condition specified for the parameter.
- (7) The test results, signed and dated.
- (8) A description of all adjustments made.

SD-07 Certificates

## Vibration Isolation;

Torsional analysis including prototype testing or calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus/minus 10%.

## Prototype Tests;

Manufacturer's standard certification that prototype tests were performed for the generator model proposed.

## Reliability and Durability;

Documentation which cites engines and generators in similar service to demonstrate compliance with the requirements of this specification. Certification does not exclude annual technological improvements made by a manufacturer in the basic standard model set on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets all the performance requirements of this specification. For each different set, 2 like sets shall have performed satisfactorily in a stationary power application, independent and separate from the physical location of the manufacturer's and assembler's facilities, for a minimum of 2 consecutive years without any failure to start, including periodic exercise. The certification shall state that for the set proposed to meet this specification, there were no failures resulting in downtime for repairs in excess of 72 hours or any failure due to overheating during 2 consecutive years of service. Like sets are of the same model, speed, bore, stroke, number and configuration of cylinders, and output power rating. Like generators are of the same model, speed, pitch, cooling, exciter, voltage regulator and output power rating. A list shall be provided with the name of the installations, completion dates, and name and telephone number of a point of contact.

## Emissions;

A certification from the engine manufacturer stating that the engine exhaust emissions meet federal, state, and local regulations and restrictions specified. At a minimum, this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HAPs).

## Sound limitations;

A certification from the manufacturer stating that the sound emissions meet the specification.

## Flywheel Balance;

Manufacturer's certification that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125% of rated speed without vibration or damage.

#### Materials and Equipment;

A letter stating that where materials or equipment are specified to comply with requirements of UL, or other standards, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

#### Factory Inspection and Tests;

A certification that each engine generator set passed the factory tests and inspections and a list of the test and inspections.

#### Inspections;

A letter certifying that all facilities are complete and functional, that each system is fully functional, and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

#### Cooling System;

Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

### 1.3 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine generator set shall satisfy the requirements specified in the Engine Generator Parameter Schedule.

#### 1.3.1 Engine-Generator Parameter Schedule

##### ENGINE GENERATOR PARAMETER SCHEDULE

Service Load	150 kW
Power Factor	0.8 lagging
Motor Starting kVA (maximum)	510 kVA
Maximum Speed	1800 rpm

Engine-Generator Application	stand-alone
Engine Cooling Type	ethylene glycol
Heat Exchanger Type	shell-tube
Governor Type	Isochronous
Voltage Regulation (No load to full load)	$\pm 2\%$ (max.)
Frequency	60 Hz
Voltage	277/480 volts
Phases	3 Phase, Wye 4 Wires
Max Step Load Increase	100% of Service Load at .8 PF
Max Step Load Decrease (without shutdown)	100 % of Service Load at _____ PF
Max Time to Start and be Ready to Assume Load	10 seconds

#### 1.3.2 Output Capacity

Each generator set shall provide power equal to the sum of service load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

#### 1.3.3 Power Rating

Standby ratings shall be in accordance with EGSA 101P.

### 1.4 GENERAL REQUIREMENTS

#### 1.4.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter, mounted, assembled, and aligned on one base; and all other necessary ancillary equipment which may be mounted separately. Sets shall be assembled and attached to the base prior to shipping. Set components shall be environmentally suitable for the locations shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. A generator strip heater shall be provided for moisture control when the generator is not operating.

#### 1.4.2 Nameplates

Each major component of this specification shall have the manufacturer's

name, type or style, model or serial number, and rating number on a plate secured to the equipment. As a minimum, nameplates shall be provided for: Engines; Relays; Generators; Day tanks; Transformers (CT & PT); Regulators; Pumps and pump motors; Governors; Generator Breaker; Economizers.

Engines	Relays
Generators	Fuel tanks
Transformers (CT & PT)	Regulators
Pumps and pump motors	Governors
Generator Breakers	Economizers
Heat exchangers (other than base-mounted)	

Where the following equipment is provided as a standard component by the diesel-engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger	Heaters
Exhaust mufflers	Exciters
Silencers	
Battery	

#### 1.4.3 Personnel Safety Device

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel during normal operation shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed so that proper operation of the equipment is not impaired.

#### 1.4.4 Verification of Dimensions

Before performing work, the premises shall be visited and details of the work verified. The Contracting Officer shall be advised in writing of any discrepancies before performing any work.

#### 1.4.5 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, the design, fabrication and installation shall conform to the code.

#### 1.4.6 Site Welding

Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL. For all other welding, procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1.

Welder qualification tests shall be performed for each welder whose qualifications are not in compliance with the referenced standards. The Contracting Officer shall be notified 24 hours in advance of qualification tests. The qualification tests shall be performed at the work site if practical. The welder or welding operator shall apply the assigned personal symbol near each weld made as a permanent record

#### 1.4.7 Engine Generator Set Enclosure

The engine generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at rated load under secured conditions. Doors shall be provided for access to all controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than exhaust system. The enclosure shall reduce the noise of the generator set to within the limits specified in the paragraph SOUND LIMITATIONS.

#### 1.4.8 Vibration Isolation

The maximum engine-generator set vibration in the horizontal, vertical and axial directions shall be limited to 6 mils (peak-peak RMS), with an overall velocity limit of RMS, for all speeds through 110% of rated speed.

The engine-generator set shall be provided with vibration-isolation in accordance with the manufacturer's standard recommendation.

#### 1.4.9 Experience

Each component manufacturer shall have a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacture/assembler shall have a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

#### 1.4.10 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer shall have attended the engine-generator manufacturer's training courses on installation and operation and maintenance for engine generator sets.

### 1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment in accordance with the manufacturers recommended storage procedures, before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

## 1.6 OPERATION AND MAINTENANCE MANUALS

The operation and maintenance manuals shall be submitted and approved prior to commencing onsite tests.

### 1.6.1 Operation Manual

Three copies of the manufacturers standard operation manual and operation manual in 8-1/2 x 11 inch three-ring binders shall be provided. Sections shall be separated by heavy plastic dividers with tabs which identify the material in the section. Drawings shall be folded blue lines, with the title block visible, and placed in 8-1/2 x 11 inch plastic pockets with reinforced holes. The manual shall include:

- a. Step-by-step procedures for system startup, operation, and shutdown;
- b. Drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems with their controls, alarms, and safety systems;
- c. Procedures for interface and interaction with related systems to include automatic transfer switches, fire alarm/suppression systems.

### 1.6.2 Maintenance Manual

Three copies of the manufacturers standard maintenance manual containing the information described below in 8-1/2 x 11 inch three-ring binders shall be provided. Each section shall be separated by a heavy plastic divider with tabs. Drawings shall be folded, with the title block visible, and placed in plastic pockets with reinforced holes.

- a. Procedures for each routine maintenance item. Procedures for troubleshooting. Factory-service, take-down overhaul, and repair service manuals, with parts lists.
- b. The manufacturer's recommended maintenance schedule.
- c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components listed in paragraph GENERAL REQUIREMENTS.
- d. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

## 1.7 SPECIAL TOOLS AND FILTERS

Two sets of special tools and two sets of filters required for maintenance shall be provided. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings. Two complete sets of

filters shall be supplied in a suitable storage box. these filters shall be in addition to filters replaced after testing.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

The generator shall be a pad-mounted unit wiht weatherproof, sound-limiting enclosure, base-mounted fuel tank, day tank, batteries, charger, engine and radiator heating, main circuit breaker, etc. Materials and equipment shall be as specified.

#### 2.1.1 Circuit Breakers, Low Voltage

NEMA AB 1, UL 489, and NEMA SG 3.

#### 2.1.2 Filter Elements (Fuel-oil, Lubricating-oil, and Combustion-air)

Manufacturer's standard.

#### 2.1.3 Instrument Transformers

ANSI C12.11.

#### 2.1.4 Pipe (Sleeves, Fuel/Lube-oil, Coolant and Exhaust)

ASTM A 53/A 53M, ASTM A 106 or ASTM A 135, steel pipe. Pipe smaller than 2 inches shall be Schedule 80. Pipe 2 inches and larger shall be Schedule 40.

#### 2.1.5 Pipe Flanges and Fittings

- a. Pipe Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.
- b. Pipe Welding Fittings: ASTM A 234/A 234M, Grade WPB or WPC, Class 150, or ASME B16.11, 3000 lb.
- c. Threaded Fittings: ASME B16.3, Class 150.
- d. Valves: MSS SP-80, Class 150.
- e. Gaskets: Manufacturers Standard.

#### 2.1.6 Pipe Hangers

MSS SP-58 and MSS SP-69.

#### 2.1.7 Electrical Enclosures

##### 2.1.7.1 General

NEMA ICS 6.



### 2.1.8 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings, a maximum speed of 1800 rpm and integral automatic or manual reset thermal overload protectors. Motors used indoors shall have drip proof frames; those used outside shall be totally enclosed.

AC motors larger than 1/2 Hp shall be of the squirrel cage induction type for standard voltage of 460 volts, 60 Hz, three phase power. AC motors 1/2 Hp or smaller, shall be for standard voltage 115 volts, 60 Hz, single phase power.

### 2.1.9 Motor Controllers

Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

## 2.2 ENGINE

Each engine shall operate on No. 2-D diesel conforming to ASTM D 975, shall be designed for stationary applications and shall be complete with ancillaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall be naturally aspirated, scavenged, supercharged or turbocharged. The engine shall be two- or four-stroke-cycle and compression-ignition type. The engine shall be vertical inline, V-, or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have no less than four cylinders. Each block shall have a coolant drain port. Each engine shall be equipped with an overspeed sensor.

## 2.3 FUEL SYSTEM

The fuel system for each engine generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

### 2.3.1 Pumps

#### 2.3.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. The fuel flow rate shall be based on meeting the load requirements and all necessary recirculation.

#### 2.3.1.2 Auxiliary Fuel Pump

Auxiliary fuel pumps shall be provided to maintain the required engine fuel pressure, either required by the installation or indicated on the drawings.

The auxiliary pump shall be driven by a dc electric motor powered by the starting/station batteries. The auxiliary pump shall be automatically actuated by a pressure detecting device.

### 2.3.2 Filter

A minimum of one full flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

### 2.3.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line, and prevent the build-up of excessive pressure in the fuel system.

### 2.3.4 Integral Main Fuel Storage Tank

Each engine shall be provided with an integral main fuel tank. Each tank shall be factory installed and provided as an integral part of the diesel generator manufacturer's product. Each tank shall be provided with connections for fuel supply line, fuel return line, local fuel fill port, gauge, vent line, and float switch assembly. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the tank shall be below the flash point of the fuel. Each engine-generator set provided with weatherproof enclosures shall have its tank mounted within the enclosure. The fuel fill line shall be accessible without opening the enclosure.

#### 2.3.4.1 Capacity

Each tank shall have capacity to supply fuel to the engine for an uninterrupted 12-hour period at 100% rated load without being refilled.

#### 2.3.4.2 Local Fuel Fill

Each local fuel fill port on the fuel tank shall be provided with a screw-on cap.

#### 2.3.4.3 Fuel Level Controls

- a. Each tank shall have a float-switch assembly to perform the following functions:
  - (1) Activate the "Low Fuel Level" alarm at 70% of the rated tank capacity.
  - (2) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank capacity.

#### 2.3.4.4 Arrangement

Integral tanks may allow gravity flow into the engine. Gravity flow tanks and any tank that allows a fuel level above the fuel injectors shall be provided with an internal or external factory installed valve located as near as possible to the shell of the tank. The valve shall close when the

engine is not operating. Integral day tanks shall be provided with any necessary pumps to supply fuel to the engine as recommended by the generator set manufacturer. The fuel supply line from the tank to the manufacturer's standard engine connection shall be welded pipe.

#### 2.3.5 Capacity, Standby

Each day tank shall have capacity to supply fuel to the engine for an uninterrupted 1-hour period at 100% rated load without being refilled, plus any fuel which may be returned to the main fuel storage tank. The calculation of the capacity of each day tank shall incorporate the requirement to stop the supply of fuel into the day tank at 90% of the ultimate volume of the tank.

#### 2.3.6 Drain Line

Each day tank drain line shall be accessible and equipped with a shutoff valve. Self supporting day tanks shall be arranged to allow drainage into a 12 inch tall bucket.

#### 2.3.7 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

#### 2.3.8 Fuel Level Controls

- a. Each day tank shall have a float-switch-assembly to perform the following functions:
  - (1) When the main storage tank is located higher than the day tank, open the solenoid valve located on the fuel supply line entering the day tank and start the supply of fuel into the day tank. Start the supply of fuel into the day tank when the fuel level is at the "Low" level mark, 75% of the rated tank capacity.
  - (2) When the main storage tank is located higher than the day tank, stop the supply of fuel into the day tank and close the solenoid valve located on the fuel supply line entering the day tank. Stop the supply of fuel into the day tank when the fuel level is at 90% of the rated tank capacity.
  - (3) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank volume.
  - (4) Activate the "Low Fuel Level" alarm at 70% of the rated tank Capacity.
  - (5) Activate the automatic fuel supply shut-off valve located on the fill line of the day tank and shut down the fuel pump which supplies fuel to the day tank at 95% of the rated tank volume. The flow of fuel shall be stopped before any fuel can be forced into the fuel overflow line.

### 2.3.9 Arrangement

Integral day tanks may allow gravity flow into the engine. Gravity flow tanks shall be provided with an internal or external valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating. Integral day tanks shall be provided with any necessary pumps to supply fuel to the engine as recommended by the generator set manufacturer. The overflow connection and the fuel supply line for integral day tanks which do not rely upon gravity flow shall be arranged so that the highest possible fuel level is below the fuel injectors. Self-supporting day tank shall either be arranged so that the fuel level in the day tank remains above the suction port of the engine driven fuel pump or be provided with a transfer pump to provide fuel to the engine driven pump. The overflow connection and fuel supply line shall be arranged so that the highest possible fuel level is below the fuel injectors. When the main fuel storage tanks are located below the day tank, a check valve shall be provided in the fuel supply line entering the day tank. When the main fuel storage tanks are located above the day tank, a solenoid valve shall be installed in the fuel supply line entering the day tank. The solenoid valve shall be in addition to the automatic fuel shut off valve. The fuel supply line from the day tank to the manufacturer's standard engine connection shall be welded pipe.

### 2.3.10 Fuel Supply System

The fuel supply from the main storage of fuel to the day tank shall be as specified in Section 13202A FUEL STORAGE SYSTEMS.

## 2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven oil pumps. Each system shall be furnished with a relief valve for oil pressure regulation (for closed systems) and a dip-stick for oil level indications. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

### 2.4.1 Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

### 2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil pressure sensors. Pressure sensors shall be located downstream of the filters and provide signals for

required indication and alarms.

## 2.5 COOLING SYSTEM

Each engine cooling system shall operate automatically while the engine is running. Each cooling system shall be sized for the maximum summer outdoor or indoor design temperature and site elevation. Water-cooled system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across the engine shall be no more than that recommended and submitted in accordance with paragraph SUBMITTALS.

### 2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers.

### 2.5.2 Heat Exchanger

Each heat exchanger shall be of a size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted in accordance with paragraph SUBMITTALS for the maximum summer outdoor design temperature and site elevation. Each heat exchanger shall be corrosion resistant, suitable for service in ambient conditions of application.

#### 2.5.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film providing that corrosion measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via oversizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 7 psi. Each heat exchanger shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes. One tapped hole in the heat exchanger shall be equipped with a drain cock, the rest shall be plugged.

### 2.5.3 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

## 2.6 SOUND LIMITATIONS

The noise generated by the diesel generator set operating at 100 percent load shall not exceed the following sound pressure levels in any of the indicated frequencies when measured in a free field at a radial distance of

22.9 feet at 45 degrees apart in all directions.

Frequency Band (Hz)	Maximum Acceptable Pressure Level (Decibels)
31	81
63	81
125	71
250	64
500	58
1,000	55
2,000	54
4,000	54
8,000	56

## 2.7 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer.

Silencer shall be capable of reducing the noise level at the air intake to a point below the maximum acceptable levels specified in paragraph SOUND LIMITATIONS. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines shall be copper.

## 2.8 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported so as to minimize vibration. Where a V-type engine is provided, a V-type connector with necessary flexible sections and hardware shall connect the engine exhaust outlets.

### 2.8.1 Flexible Sections and Expansion Joints

A flexible section at each engine and an expansion joint at each muffler shall be provided. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

### 2.8.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for outside horizontal mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer.

Outside mufflers shall be zinc coated or painted with high temperature 400 degrees F resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

#### 2.8.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a condensate trap and drain valve. Changes in direction shall be long-radius. Exhaust piping, mufflers and silencers installed inside any building shall be insulated in accordance with paragraph THERMAL INSULATION and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity operated, self-closing, rain cover.

#### 2.9 EMISSIONS

The finished installation shall comply with Federal, state, and local regulations and restrictions regarding the limits of emissions.

#### 2.10 STARTING SYSTEM

The starting system for standby engine generator sets used in emergency applications shall be in accordance with NFPA 99 and NFPA 110 and as follows.

##### 2.10.1 Controls

An engine control switch shall be provided with functions including: run/start (manual), off/reset, and automatic mode. Start-stop logic shall be provided for adjustable cycle cranking and cool down operation. The logic shall be arranged for manual starting and fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR SET SYSTEM OPERATION. Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

##### 2.10.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor or indoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three cranking periods with 15-second intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds.

##### 2.10.3 Functional Requirements

Starting system shall be manufacturers recommended dc system utilizing a negative circuit ground. Starting motors shall be in accordance with SAE ARP892.

##### 2.10.4 Battery

A starting battery system shall be provided and shall include the battery,

battery rack, intercell connectors, and spacers. The battery shall be in accordance with SAE J537. Critical system components (rack, protection, etc.) shall be sized to withstand the seismic acceleration forces specified. The battery shall be lead-acid, nickel-cadmium type, with sufficient capacity, at the minimum outdoor and indoor winter temperature specified to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable.

#### 2.10.5 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize charging rate for recharging fully depleted batteries within 24 hours and a float charge rate for maintaining the batteries in prime starting condition. An ammeter shall be provided to indicate charging rate. A timer shall be provided for the equalize charging rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

#### 2.10.6 Starting Aids

The manufacturer shall provide one or more of the following methods to assist engine starting.

##### 2.10.6.1 Glow Plugs

Glow plugs shall be designed to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of minus 25 degrees F.

##### 2.10.6.2 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. The control temperature shall be the temperature recommended by the engine manufacturer to meet the starting time specified.

#### 2.11 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100% of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine generator set, without special tools, from 90 to 110 % of the rated speed/frequency, over a steady state load range of zero to 100% of rated capacity. Isochronous governors shall maintain the midpoint of the frequency bandwidth at the same value for steady-state loads over the range of zero to 100% of rated output capacity. Droop governors shall maintain the midpoint of the frequency bandwidth linearly for steady-state loads over the range of zero to 100% of rated output capacity, with 3% droop.



## 2.12 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Insulation shall be Class H or Class F. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 100 percent. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type.

### 2.12.1 Current Balance

At 100 percent rated load, and load impedance equal for each of the three phases, the permissible current difference between any two phases shall not exceed 2 percent of the largest current on either of the two phases.

### 2.12.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated load, the difference in line-to-neutral voltage among the three phases shall not exceed 1 percent of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other two phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

### 2.12.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced full rated load at 0.8 power factor shall not exceed 10%. The RMS of all harmonics shall be less than 5.0% and that of any one harmonic less than 3.0% at full rated load. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE Std 519.

## 2.13 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300% for peak inverse voltage and forward current ratings for all operating conditions, including 110% generator output at 104 degrees F ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.

## 2.14 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter. The regulator shall maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to

100% of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine generator voltage output without special tools, during operation from 90 to 110% of the rated voltage over the steady state load range of zero to 100% of rated output capacity. Regulation drift shall not exceed plus or minus 0.5% for an ambient temperature change of 36 degrees F.

#### 2.14.1 Steady State Performance (Regulation or Voltage Droop).

The voltage regulator shall have a maximum droop of 2% of rated voltage over a load range from 0 to 100% of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

#### 2.15 GENERATOR PROTECTION

Short circuit and overload protection for the generator shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit and interrupting current ratings to match the generator capacity. The manufacturer shall determine the short circuit current interrupting rating of the breaker. The breaker shall be engine generator base mounted by the engine-generator set manufacturer. Surge protection shall be provided for each phase of the generator, to be mounted at the generator terminals.

#### 2.16 SAFETY SYSTEM

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals shall have manual acknowledgement and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

##### 2.16.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of 75 dB at 10 feet. The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.

##### 2.16.2 Visual Signal Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously light upon acknowledgement. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

## 2.16.3 Alarms and Action Logic

## 2.16.3.1 Shutdown

Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers shall be accomplished.

## 2.16.3.2 Problem

Activation of the visual signal shall be accomplished.

## 2.16.4 Local Alarm Panel

A local alarm panel shall be provided with the following shutdown and alarm functions in accordance with NFPA 99 and 110 level 2 and including the listed Corps of Engineers requirements, mounted either on or adjacent to the engine generator set.

Device/ Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2	Corps of Engrs Required
Shutdowns W/Alarms					
High engine temperature	Automatic/ jacket water/ cylinder	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Low lube-oil pressure	Automatic/ pressure/ level	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Overspeed shutdown & alarm	(110% (+ 2%) of rated speed	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Overcrank failure to start	Automatic/ Failure to to start	SD/CP VA	SD/CP VA	SD/CP VA	
Day tank overflow limit indication & transfer pump shutdown (95% volume)	Automatic/Day Tank/Level				SD/OPA (Pump)
Red emergency stop switch	Manual Switch		SD/CP VA	SD/CP VA	SD VA

Device/ Condition/ Function Failure to crank	What/Where/Size  Corps of Engrs. Required	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2	Corps of Engrs Required
Day tank Integral Main Fuel Tank low fuel limit Device/ Condition/ indication (70% volume remaining)	Corps of Engrs. Required				
Alarms					
Low lube-oil pressure	Pressure/ level	CP VA	CP VA	CP VAO	CP VA
Low fuel level	Main tank, 3 hours remaining	VA/AA	CP VA	CP VAO	
High fuel level	Integral Main Fuel Storage Tank 95% Volume				CP VA
Low coolant	Jacket water	CP/VA	CP VA	CP VA	
Pre-high temperature	Jacket water/ cylinder	CP VA	CP VA	CP VAO	CP VA
Pre-low lube-oil pressure		CP VA			CP VA
High battery voltage			CP VA	CP VAO	
Low battery voltage			CP VA	CP VAO	
Battery charger AC failure	AC supply not available		CP VA	CP VAO	
Control switch not in AUTO			CP VA	CP VAO	
Low starting			CP VA	CP VAO	

Device/ Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2	Corps of Engrs Required
air pressure					

Low starting hydraulic pressure			CP VA	CP VAO	
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SD - Shut Down

CP - On Control Panel

VA - Visual Alarm

AA - Audible Alarm

O - Optional

## 2.16.5 Time-Delay on Alarms

For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

## 2.16.6 Remote Alarm Panel

A remote alarm panel shall be provided in accordance with NFPA 99 and NFPA 110 and as follows:

Device/Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1
Remote annunciator panel	Battery powered		Alarms
Loads on genset		VA	
Battery charger malfunction		VA	
Low lube-oil	Pressure/level	VA/AA	AA
Low Temperature	Jacket water	VA/AA	AA
High Temperature	Jacket water/ cylinder	VA/AA	AA
Low fuel level	Main tank, 3 hr remaining	VA/AA	AA
Overcrank	Failure to start	VA/AA	AA
Overspeed		VA/AA	AA
Pre-high temperature	Jacket water/		AA

Device/Condition/	What/Where/Size cylinder	NFPA 99	NFPA 110
Control switch not in  AUTO			AA
Common alarm contacts for local & remote common alarm			X
Audible alarm silencing switch			X
Air shutdown damper	When used		AA
Common fault alarm			AA

X - Required  
 SD - Shut Down  
 CP - On Control Panel  
 VA - Visual Alarm  
 AA - Audible Alarm  
 O - Optional

## 2.17 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.

### 2.17.1 Controls

A local control panel shall be provided with controls in accordance with NFPA 110 level 1 mounted either on or adjacent to the engine generator set.

A remote control panel shall be provided with devices as indicated fully redundant to the local control panel.

Device/Condition/ Function	Corps Requirement	NFPA 110 Level 1	MFG Offering
Controls			
Switch: run/start - off/set - auto	CP		CP/STD
Emergency stop switch & alarm	CP		CP/STD
Lamp test/indicator test	CP	CP VA	CP/STD
Common alarm contacts/ fault relay		X	CP/O
Panel lighting	CP		CP/STD
Audible alarm & silencing/reset switch	CP		

Device/Condition/ Function	Corps Requirement	NFPA 110 Level 1	MFG Offering
Voltage adjust for voltage Regulator	CP		CP/STD
Pyrometer display w/selector switch	CP		
Remote emergency stop switch		CP VA	
Remote fuel shutoff switch			
Remote lube-oil shutoff switch			

### 2.17.2 Engine Generator Set Metering and Status Indication

A local panel shall be provided with devices in accordance with NFPA 110 level 1 mounted either on or adjacent to the engine generator set. A remote control panel shall be provided fully redundant to the local control panel.

Device/Condition/ Function	Corps Requirement	NFPA 110 Level 1	MFG Offering
Genset Status & Metering			
Genset supplying load		CP VA	CP VAO
System ready			CP/STD
Engine oil pressure	CP		CP/STD
Engine coolant temperature	CP		CP/STD
Engine RPM (Tachometer)	CP		CP/STD
Engine run hours	CP		CP/STD
Pyrometer display w/selector switch	CP		
AC volts (generator), 3-phase	CP		CP/STD
AC amps (generator), 3-phase	CP		CP/STD
Generator frequency	CP		CP/STD
Phase selector switches (amps & volts)	CP		CP/STD
Watts/kW			CP/VA-O
Voltage Regulator			

Device/Condition/ Function Adjustment	Corps Requirement  CP	NFPA 110 Level 1	MFG Offering
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CP - On Control Panel  
VA - Visual Alarm  
AA - Audible Alarm  
O - Optional  
STD - Manufacturers Standard Offering

## 2.18 PANELS

Each panel shall be of the type necessary to provide specified functions. Panels shall be mounted on the engine generator set base by vibration/shock absorbing type mountings. Instruments shall be mounted flush or semiflush.

Convenient access to the back of instruments shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate which clearly identifies the panel function as indicated. Each instrument and device on the panel shall be provided with a plate which clearly identifies the device and its function as indicated. Panels except the remote alarm panel can be combined into a single panel.

### 2.18.1 Enclosures

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6, and provided with locking mechanisms which are keyed alike.

### 2.18.2 Analog

Analog electrical indicating instruments shall be in accordance with ANSI C39.1 with semiflush mounting. Switchgear, and control-room panel-mounted instruments shall have 250 degree scales with an accuracy of not less than 1 percent. Unit-mounted instruments shall be the manufacturer's standard with an accuracy of not less than 2 percent. The instrument's operating temperature range shall be minus 20 to plus 65 degrees C. Distorted generator output voltage waveform of a crest factor less than 5 shall not affect metering accuracy for phase voltages, hertz and amps.

### 2.18.3 Electronic

Electronic indicating instruments shall be true RMS indicating, 100 percent solid state, microprocessor controlled to provide all specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy shall be not less than 2 percent for unit mounted devices and 1 percent for control room, panel mounted devices, throughout a temperature range of minus 20 to plus 65 degrees C. Data display shall utilize LED or back lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall



be 1/2 inch.

#### 2.18.4 Parameter Display

Indication or readouts of the lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and coolant temperature.

#### 2.18.5 Exerciser

The exerciser shall be in accordance with Section 16410A AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

#### 2.19 SURGE PROTECTION

Electrical and electronic components shall be protected from, or designed to withstand the effects of surges from switching and lightning.

#### 2.20 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Fully automatic operation shall be provided for the following operations: engine-generator set starting and source transfer upon loss of normal preferred source; retransfer upon restoration of the normal preferred source; sequential starting; and stopping of each engine-generator set after cool down. Devices shall automatically reset after termination of their function.

##### 2.20.1 Automatic Transfer Switch

Automatic transfer switches shall be in accordance with Section 16410A AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

##### 2.20.2 Monitoring and Transfer

Devices shall be provided to monitor voltage and frequency for the normal preferred power source and each engine generator set, and control transfer from the normal preferred source and retransfer upon restoration of the normal preferred source. Functions, actuation, and time delays shall be as described in Section 16410A AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

#### 2.21 MANUAL ENGINE-GENERATOR SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of each set without load, loading and unloading of each set.

#### 2.22 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of all rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment will be maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall be provided with suitable holes for foundation bolts. The base shall also withstand and mitigate the effects of

synchronous vibration of the engine and generator, and shall be provided with suitable holes for anchor bolts and jacking screws for leveling.

## 2.23 THERMAL INSULATION

Thermal insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

## 2.24 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

## 2.25 FACTORY INSPECTION AND TESTS

Factory inspection and tests shall be performed on each engine-generator set proposed to meet this specification section. Inspections shall be completed and necessary repairs made prior to testing. Inspectors shall look for leaks, looseness, defects in components, and proper assembly. Factory tests shall be NEMA MG 1 routine tests and the manufacturers routine tests.

# PART 3 EXECUTION

## 3.1 GENERAL INSTALLATION

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

## 3.2 PIPING INSTALLATION

### 3.2.1 General

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the diesel engine may be threaded if the diesel-engine manufacturer's standard connection is threaded. Except as otherwise specified, flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system.

### 3.2.2 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of all debris.

## 3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 16415A ELECTRICAL WORK, INTERIOR.

### 3.3.1 Vibration Isolation

Flexible fittings shall be provided for all conduit, cable trays, and raceways attached to engine-generator sets. Metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set shall be flexible stranded conductor. Terminations of conductors on the engine generator set shall be crimp-type terminals or lugs.

### 3.4 FIELD PAINTING

Field painting shall be as specified in Section 09900 PAINTS AND COATINGS.

### 3.5 ONSITE INSPECTION AND TESTS

#### 3.5.1 Test Conditions

##### 3.5.1.1 Data

Measurements shall be made and recorded of parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments or replacements shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be taken during engine-generator set operation and recorded in 15 minute intervals and shall include: readings of engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions and terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation shall be in accordance with IEEE Std 1.

##### 3.5.1.2 Power Factor

Engine-generator set operating tests shall be made utilizing a load with the power factor specified in the engine generator set parameter schedule.

##### 3.5.1.3 Contractor Supplied Items

The Contractor shall provide all equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

##### 3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments, provided under this specification shall be verified during test runs by test instruments of precision and accuracy greater than the tested items. Test instrument

accuracy shall be at least as follows: current, 1.5%; voltage, 1.5%; real power, 1.5%; reactive power, 1.5%; power factor, 3%; frequency, 0.5%. Test instruments shall be calibrated by a recognized standards laboratory within 30 or 90 days prior to testing.

#### 3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance is authorized by the Contracting Officer. Field testing shall be performed in the presence of the Contracting Officer. Tests may be scheduled and sequenced in order to optimize run-time periods; however the following general order of testing shall be followed: Construction Tests; Inspections; Safety run Tests; and Performance Tests and Final Inspection.

#### 3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

##### 3.5.2.1 Piping Test

- a. Lube-oil and fuel-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.
- b. Fuel piping which is external to the engine-generator set shall be tested in accordance with NFPA 30. All remaining piping which is external to the engine generator set shall be pressure tested with air pressure at 150% of the maximum anticipated working pressure, but in no case less than 150 psig, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

##### 3.5.2.2 Electrical Equipment Tests

- a. Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the distribution bus. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

$R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 304,800 / (\text{length of cable in meters}).$

$(R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 1000 / (\text{length of cable$

in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

- b. Ground-Resistance Tests. The resistance of the the ground ring shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- 1) Multiple rod electrodes - 25 ohms.

### 3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts. (I)
2. Governor type and features. (I)
3. Engine timing mark. (I)
4. Starting motor. (I)
5. Starting aids. (I)
6. Coolant type and concentration. (D)
7. Radiator drains. (I)
8. Block coolant drains. (I)
9. Coolant fill level. (I)
10. Coolant line connections. (I)
11. Coolant hoses. (I)
12. Combustion air filter. (I)
13. Intake air silencer. (I)
14. Lube oil type. (D)
15. Lube oil drain. (I)
16. Lube-oil filter. (I)
17. Lube-oil-fill level. (I)
18. Lube-oil line connections. (I)
19. Lube-oil lines. (I)
20. Fuel type. (D)

21. Fuel-level. (I)
22. Fuel-line connections. (I)
23. Fuel lines. (I)
24. Fuel filter. (I)
25. Access for maintenance. (I)
26. Voltage regulator. (I)
27. Battery-charger connections. (I)
28. Wiring & terminations. (I)
29. Instrumentation. (I)
30. Hazards to personnel. (I)
31. Base. (I)
32. Nameplates. (I)
33. Paint. (I)
34. Exhaust system. (I)
35. Access provided to controls. (I)
36. Enclosure. (I)
37. Engine & generator mounting bolts (proper application). (I)

#### 3.5.4 Safety Run Tests

- a. Perform and record engine manufacturer's recommended prestarting checks and inspections.
- b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.
- c. Activate the manual emergency stop switch and verify that the engine stops.
- d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary, provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.
- e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If temperature reading exceeds the value for an alarm condition, activate the manual emergency stop switch.
- f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.
- g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily seal their normal location on the engine and temporarily install temperature gauges in their normal locations on the engine (required for safety, not for recorded

data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

- h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize.
- i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.
- j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.
- k. Operate the engine generator-set for at least 30 minutes at 100 percent of service load.
- l. Verify proper operation of the governor and voltage regulator.
- m. Verify proper operation and setpoints of gauges and instruments.
- n. Verify proper operation of ancillary equipment.
- o. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.
- p. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of rated load.
- q. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.
- r. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine. Record the results.
- s. Attach a manifold to the engine oil system (at the oil sensor pressure port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold and its normal location on the engine temporarily sealed. The manifold shutoff valve shall be open and bleed valve closed.
- t. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75

percent of service load.

- u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.
- v. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100% of service load. Record the maximum sound level in each frequency band at a distance of 75 feet from the end of the exhaust and air intake piping directly along the path of intake and discharge horizontal piping; or at a radius of 35 feet from the engine at 45 degrees apart in all directions for vertical piping. The measurements should comply with the paragraph SOUND LIMITATIONS. If a sound limiting enclosure is provided, the enclosure, the muffler, and intake silencer shall be modified or replaced as required to meet the sound requirements contained within this specification.
- w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low level alarm limits.

### 3.5.5 Performance Tests

#### 3.5.5.1 Continuous Engine Load Run Test

The engine-generator set and ancillary systems shall be tested at service load to: demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. The engine load run test shall be accomplished principally during daylight hours. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Data taken at 15 minutes intervals shall include the following:

- a. Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.
- b. Pressure: Lube-oil.



- c. Temperature: Coolant.  
Lube-oil.  
Ambient.

- (1) Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.
- (2) Start the engine; make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.
- (3) Operate the engine generator-set for at least 2 hours at 75 percent of service load.
- (4) Increase load to 100% of service load and operate the engine generator-set for at least 2 hours.
- (5) Remove load from the engine-generator set.

#### 3.5.5.2 Load Acceptance Test

Engine manufacturer's recommended prestarting checks and inspections shall be performed and recorded. The engine shall be started, and engine manufacturer's after-starting checks and inspections made and recorded during a reasonable warm-up period. For the following steps, the output line-line and line-neutral voltages and frequency shall be recorded after performing each step instruction (after stabilization of voltage and frequency). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.

- a. Apply load in steps no larger than the Maximum Step Load Increase to load the engine-generator set to 100 of Service Load.
- b. Verify that the engine-generator set responds to the load addition and that the output voltage returns to and stabilizes within the rated bandwidths.

#### 3.5.6 Automatic Operation Tests for Stand-Alone Operation

The automatic loading system shall be tested to demonstrate automatic starting. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:

- a. Ambient temperature (at 15 minute intervals).
- b. Generator output current (before and after load changes).
- c. Generator output voltage (before and after load changes).
- d. Generator output frequency (before and after load changes.)

1. Initiate loss of the primary power source and verify automatic sequence of operation.
2. Restore the primary power source and verify sequence of operation.
3. Verify resetting of controls to normal.

### 3.6 FINAL INSPECTION AND TESTING

- a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.
- b. Increase the load in steps no greater than the maximum step load increase to 100% of service load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.
- c. Remove load and shut down the engine-generator set after the recommended cool down period. Perform the pre-test inspections and take necessary corrective actions.
- d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 4 hours at service load, then re-examining the oil and filter.
- e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.
- f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.
- g. Replace air, oil, and fuel filters with new filters.

### 3.7 MANUFACTURER'S FIELD SERVICE

#### 3.7.1 Onsite Training

The Contractor shall conduct training course for operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations such as oil change,

oil filter change, and air filter change.

#### 3.7.2 Manufacturer's Representative

The engine generator-set manufacturer shall furnish a qualified representative to supervise the installation of the engine generator-set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

#### 3.8 INSTRUCTIONS

Two sets of instructions shall be typed in 8 1/2 x 11 inches format, laminated in weatherproof plastic, and placed in three-ring vinyl binders. The binders shall be placed as directed by the Contracting Officer. The instructions shall be in place prior to acceptance of the engine generator set installation. First set of instructions shall include a one-line diagram, wiring and control diagrams and a complete layout of the system. Second set of instructions shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as automatic transfer switches).

#### 3.9 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and after all defects in installation material or operation have been corrected.

-- End of Section --

## SECTION 16375A

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND  
02/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C119.1	(1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C12.10	(1997) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C12.4	(1984; R 1996) Mechanical Demand Registers
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
ANSI C29.1	(1988; R 1996) Electrical Power Insulators - Test Methods
ANSI C37.121	(1989; R 1995) Switchgear, Unit Substations Requirements
ANSI C37.16	(2000) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C37.46	(1981; R 1992) Power Fuses and Fuse Disconnecting Switches
ANSI C37.50	(1989; R 1995) Switchgear, Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures
ANSI C37.72	(1987) Manually-Operated, Dead-Front Padmounted Switchgear with Load Interrupting Switches and Separable Connectors for Alternating-Current Systems

ANSI C57.12.13	(1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations
ANSI C57.12.21	(1995) Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; (High-Voltage, 34 500 Grd Y/19 920 Volts and Below; Low-Voltage, 240/120; 167 kVA and Smaller)
ANSI C57.12.26	(1993) Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVA and Smaller
ANSI C57.12.27	(1982) Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations
ANSI C57.12.28	(1999) Switchgear and Transformers - Padmounted Equipment - Enclosure Integrity
ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2001) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 48	(1994a1) Gray Iron Castings
ASTM A 48M	(1994e1) Gray Iron Castings (Metric)
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 231/B 231M	(1999) Concentric-Lay-Stranded Aluminum 1350 Conductors
ASTM B 3	(1995) Soft or Annealed Copper Wire
ASTM B 400	(1994) Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductor

ASTM B 496	(1999) Compact Round Concentric-Lay-Stranded Copper Conductors
ASTM B 609/B 609M	(1999) Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical purposes
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 800	(2000) 8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers
ASTM B 801	(1999) Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2472	(2000) Sulfur Hexafluoride
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM D 923	(1997) Sampling Electrical Insulating Liquids

## ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994; CS5a-1995) Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
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## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
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IEEE C37.1	(1994) IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control
IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.2	(1996) Electrical Power System Device Function Numbers and Contact Designations
IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C37.20.2	(1993; C37.20.2b) Metal-Clad and Station-Type Cubicle Switchgear
IEEE C37.20.3	(1997) Metal-Enclosed Interrupter Switchgear
IEEE C37.23	(1987; R 1991) Guide for Metal-Enclosed Bus and Calculating Losses in Isolated-Phase Bus
IEEE C37.30	(1997) Requirements for High-Voltage Switches
IEEE C37.34	(1994) Test Code for High-Voltage Air Switches
IEEE C37.41	(1994; C37.41c) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE C37.63	(1997) Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizer for AC Systems
IEEE C37.90	(1989; R 1994) Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C37.90.1	(1989; R 1994) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE C37.98	(1987; R 1991) Seismic Testing of Relays
IEEE C57.12.00	(1993) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(1993) Instrument Transformers

IEEE C57.98	(1993) Guide for Transformer Impulse Tests \Savail only as part of Distribution, Power, and Regulating Transformers Stds Collection
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.11	(1999) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis
IEEE Std 404	(1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V
IEEE Std 48	(1998) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 592	(1990; R 1996) Exposed Semiconducting Shields on Premolded High Voltage Cable Joints and Separable Insulated Connectors
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) \S31.00\$\F

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
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NEMA BU 1	(1994) Busways
NEMA FB 1	(1993) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA LA 1	(1992) Surge Arresters
NEMA PB 1	(1995) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA SG 2	(1993) High Voltage Fuses
NEMA SG 3	(1995) Power Switching Equipment
NEMA SG 5	(1995) Power Switchgear Assemblies
NEMA TC 5	(1990) Corrugated Polyolefin Coilable Plastic Utilities Duct
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 7	(1990) Smooth-Wall Coilable Polyethylene Electrical Plastic Duct
NEMA WC 7	(1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1988; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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## UNDERWRITERS LABORATORIES (UL)

UL 1072	(1995; Rev Mar 1998) Medium Voltage Power Cables
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1684	(2000) Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

UL 198C	(1986; Rev thru Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 854	(1996; Rev Oct 1999) Service-Entrance Cables
UL 857	(1994; Rev thru Dec 1999) Busways and Associated Fittings

## 1.2 GENERAL REQUIREMENTS

### 1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

## Electrical Distribution System

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

- a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.
- b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

- a. Medium-voltage cables and accessories including cable installation plan.
- b. Transformers.
- c. Surge arresters.

## As-Built Drawings

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and

changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction.

The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

#### SD-03 Product Data

##### Nameplates

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

##### Material and Equipment

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

##### General Installation Requirements

As a minimum, installation procedures for transformers, substations, switchgear, and medium-voltage cable terminations and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

#### SD-06 Test Reports

##### Factory Tests

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

### Field Testing

A proposed field test plan, 20 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

### Operating Tests

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The condition specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.

### Cable Installation

Six copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

- a. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.
- b. The cable manufacturer and type of cable.
- c. The dates of cable pulls, time of day, and ambient temperature.

### SD-07 Certificates

#### Material and Equipment

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards

of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements.

The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

#### Cable Joints

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

#### Cable Installer Qualifications

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

#### SD-10 Operation and Maintenance Data

##### Electrical Distribution System

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than 1 inch in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

#### 1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

### PART 2 PRODUCTS

#### 2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years

prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

## 2.2 NAMEPLATES

### 2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

### 2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE C57.12.00. Nameplates shall indicate the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 50 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 50 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

## 2.3 CORROSION PROTECTION

### 2.3.1 Aluminum Materials

Aluminum shall not be used.

### 2.3.2 Ferrous Metal Materials

#### 2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

#### 2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1,



(procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

#### 2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTS AND COATINGS.

#### 2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

##### 2.4.1 Medium-Voltage Cables

###### 2.4.1.1 General

Cable construction shall be Type MV, conforming to NFPA 70 and UL 1072. Cables shall be manufactured for use in duct applications.

###### 2.4.1.2 Ratings

Cables shall be rated for a circuit voltage of 15 kV.

###### 2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding or ASTM B 496 for compact stranding.

###### 2.4.1.4 Insulation

Cable insulation shall be ethylene-propylene-rubber (EPR) insulation conforming to the requirements of NEMA WC 8 and AEIC CS6. A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables.

###### 2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape shield for each phase. The shield tape shall be sized to meet IEEE C2 requirements for a ground fault availability of 40,000 amperes.

###### 2.4.1.6 Jackets

Cables shall be provided with a PVC jacket. Direct buried cables shall be rated for direct burial.

#### 2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

##### 2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592.

Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

#### 2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

#### 2.5.3 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

##### 2.5.3.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Anti-tracking tape shall be applied over exposed insulation of preformed molded elastomer terminations.

##### 2.5.3.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations

shall be at least 12-1/2 inches long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

## 2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application.

### 2.6.1 Nonmetallic Ducts

#### 2.6.1.1 Bituminized Fiber Duct

UL 1684 for Type I (Thinwall).

#### 2.6.1.2 Direct Burial

UL 651 Schedule 80, or NEMA TC 6 Type DB.

### 2.6.2 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 35 degrees F, shall neither slump at a temperature of 300 degrees F, nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

## 2.7 TRANSFORMERS

Transformers shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

### 2.7.1 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.26 and shall be of the radial type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

## 2.7.1.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction with cable terminators, lightning arresters, and fused load break switches.

## 2.7.1.2 Transformer Tank Sections

Transformers shall comply with IEEE C57.12.00, ANSI C57.12.21, and ANSI C57.12.26 and shall be of the mineral oil-insulated type. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be Primary-Delta/Secondary-Wye connected as follows:

Three-phase capacity.....as indicated on the Drawings.

Impedance.....5% (+/-7.5%).

Temperature Rise.....65 degrees C.

High-voltage winding.....13,200 volts\*.

High-voltage winding connections.....cable.

Low-voltage winding.....as indicated on the Drawings.

Low-voltage winding connections..... cable.

Audible Sound level .....57 dB.

BIL Rating.....95.

\*VERIFY TO MATCH EXISTING PRIMARY ELECTRIC SERVICE.

## 2.7.1.3 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

## 2.7.1.4 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station.

Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

#### 2.7.1.5 Poly-Phase Watthour Electric Meter with Meter Socket

The poly-phase or single-phase watthour electric meter shall conform to ANSI C12.1 and ANSI C12.10 , and shall be a solid-state device that meters electricity usage and registers collected information, storing processed energy use and demand data on a demand basis. Meter shall possess internal non-volatile memory that will record the latest energy totals in case of a power failure. The device shall be provided with a solid state KYZ relay board to provide output pulses for user definable increment of reported energy. The meter unit shall possess an integral optical port to allow the user to input or retrieve data. Meter shall have provisions for a communications option board to provide for a future internal modem for remote metering applications. The communications option board will allow the report of data from the meter to a central processing location. Meter sockets shall conform to ANSI C12.10. Each meter shall be factory programmed with the factory programming and shall be shipped with a copy of factory programming printout and an Operational Manual. Meter furnished without factory programming, programming printout, and Operational Manual will be rejected. (Meter shall be "ABB Alpha Power Plus".) (Meter shall be "ABB Alpha Power Plus", Form 9S, with 13 terminal socket.) The meter shall be factory programmed for CT ratio of 1000/5, and for 208Y/120 volts or 480Y/277 volts, 3-phase, 4-wire, delta wye service.

- (X) Segment Test
- (X) Account Id
- (X) Maximum indicating demand
- (X) Cumulative demand
- (X) Previous period maximum indicating demand
- (X) Previous period cumulative demand
- (X) Current interval demand
- (X) Previous interval demand
- (X) Cumulative number of optical communications
- (X) Number of days since last demand reset
- (X) Number of days since last meter pulse
- (X) Cumulative number of demand resets
- (X) Cumulative number of power outages
- (X) Cumulative pulses since last reset
- (X) Wh per pulse (Ke)
- (X) Wh per disk revolution (kh)
- (X) Demand overload value
- (X) Rate ID number
- (X) Block and subinterval length
- (X) Pulses per meter disk revolution
- (X) System error flag (Er Code)
- (X) System warning flag (F Code)

#### 2.8 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be

intermediate class, rated as shown. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the combination valve-metal-oxide varistor type.

## 2.9 GROUNDING AND BONDING

### 2.9.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467, not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used.

### 2.9.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

## 2.10 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03200A CONCRETE REINFORCEMENT.

## 2.11 PADLOCKS

Padlocks shall be as directed.

## 2.12 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

### 2.12.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

### 2.12.2 Fireproofing Tape

Fireproofing tape shall be at least 2 inches wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for

fireproofing cables.

#### 2.12.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 10 mil thick, conforming to UL 510.

#### 2.13 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil.

#### 2.14 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

- a. Transformers: Manufacturer's standard routine, design, and other tests in accordance with IEEE C57.12.00.
- b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE C57.98.

### PART 3 EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

##### 3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

##### 3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

#### 3.2 CABLE INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures,

moisture seals, testing for and purging moisture, etc. The Contractor shall then prepare a checklist of significant requirements and perform pulling calculations and prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

### 3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

#### 3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

#### 3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 1/4 inch less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 8 cubic inches of debris is expelled from the duct.

#### 3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

#### 3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 50 degrees F temperature for at least 24 hours before installation.

#### 3.2.1.5 Cable Installation Plan

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:



- a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.
- b. List of cable installation equipment.
- c. Lubricant manufacturer's application instructions.
- d. Procedure for resealing cable ends to prevent moisture from entering cable.
- e. Cable pulling tension calculations of all cable pulls.
- f. Cable percentage conduit fill.
- g. Cable sidewall thrust pressure.
- h. Cable minimum bend radius and minimum diameter of pulling wheels used.
- i. Cable jam ratio.
- j. Maximum allowable pulling tension on each different type and size of conductor.
- k. Maximum allowable pulling tension on pulling device.

#### 3.2.2 Duct Line

Medium-voltage cables shall be installed in duct lines where indicated. Cable joints in medium-voltage cables shall be made in manholes. Grounding conductors shall be installed in the same duct with their associated phase conductors.

#### 3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable.

#### 3.4 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing. Fire-stops shall be installed in each conduit leaving a manhole.

### 3.4.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

### 3.4.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825a. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

## 3.5 DUCT LINES

### 3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

### 3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid.

Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

### 3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 6 inches in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 5 feet below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically.

### 3.5.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

#### 3.5.4.1 Bituminized-Fiber Ducts

Bituminized-fiber ducts shall be used to interface with existing bituminized-fiber duct. To ensure a watertight joint, tapered ends or joints of the same material as the ducts shall be swabbed with bituminous or joint-sealing compound before couplings are applied. Plastic or nonmetallic couplings shall be tightly driven onto unswabbed ducts. Due to the brittleness of plastic couplings at low temperatures, such couplings shall not be installed when temperatures are below 0 degrees F. Couplings shall be warmed in hot water or by another approved method when installed at temperatures below 32 degrees F.

#### 3.5.4.2 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set

the joint tightly.

#### 3.5.5 Duct Line Markers

A 5 mil brightly colored plastic tape, not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

#### 3.6 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

##### 3.6.1 Concrete Pads

###### 3.6.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 4 inches above finished paving or grade and sloped to drain. Edges of concrete pads shall have 3/4 inch chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

###### 3.6.1.2 Concrete and Reinforcement

Concrete work shall have minimum 3000 psi compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03200A CONCRETE REINFORCEMENT.

###### 3.6.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

### 3.6.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed as directed by the Contracting Officer.

### 3.7 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer, a switchgear ground bus, to the ground ring.

#### 3.7.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

- a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 1 foot below finished grade.
- b. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed 12 inches, plus or minus 3 inches, below finished top of soil grade. Ground ring conductors shall be sized as shown, No. 2 AWG, minimum.
- d. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors as indicated to achieve the specified ground resistance. The additional electrodes will be up to three, 10 feet rods spaced a minimum of 10 feet apart a single extension-type rod, 3/4 inch diameter, up to 30 feet long, driven perpendicular to grade. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

#### 3.7.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

#### 3.7.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode

system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

#### 3.7.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

### 3.8 FIELD TESTING

#### 3.8.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 10 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

#### 3.8.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

#### 3.8.3 Ground-Resistance Tests

The resistance of the ground ring shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Ground ring - 5 ohms.

#### 3.8.4 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

#### 3.8.5 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers. Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

- a. Insulation resistance test phase-to-ground.
- b. Turns ratio test.
- c. Correct phase sequence.
- d. Correct operation of tap changer.

#### 3.8.6 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

### 3.9 MANUFACTURER'S FIELD SERVICE

#### 3.9.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The

course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations.

#### 3.9.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

#### 3.10 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --



## SECTION 16403A

MOTOR CONTROL CENTERS, SWITCHBOARDS  
**08/95**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |            |   |
|------------|---|
| ASTM B 187 | (1994) Copper Bar, Bus Bar, Rod and Shapes  |
| ASTM B 317 | (1992a) Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, and Structural Shapes for Electrical Purposes (Bus Conductor) |

## ASME INTERNATIONAL (ASME)

- |              |  |
|--------------|--|
| ASME B1.1    | (1989) Unified Inch Screw Threads (UN and UNR Thread Form) |
| ASME B1.20.1 | (1983; R 1992) Pipe Threads, General Purpose (Inch)        |

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- |             |  |
|-------------|--|
| IEEE C12.1  | (1988) Code for Electricity Metering   |
| IEEE C12.4  | (1984; R 1990) Mechanical Demand Registers   |
| IEEE C12.10 | (1987) Electromechanical Watthour Meters   |
| IEEE C12.11 | (1987) Instrument Transformers for Revenue Metering, 10 kV BIL Through 350 kV (0.6 kV NSV Through 69 kV NSV) |
| IEEE C57.13 | (1993) Instrument Transformers   |

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- |            |   |
|------------|---|
| NEMA AB 1  | (1993) Molded Case Circuit Breakers and Molded Case Switches  |
| NEMA ICS 1 | (1993) Industrial Control and Systems                         |
| NEMA ICS 2 | (1993) Industrial Control Devices, Controllers and Assemblies |

NEMA ICS 4	(1993) Industrial Control and Systems Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA PB 1	(1990) Panelboards
NEMA PB 2	(1989) Deadfront Distribution Switchboards
NEMA ST 1	(1988) Specialty Transformers (Except General Purpose Type)
NEMA ST 20	(1992) Dry-Type Transformers for General Applications

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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## UNDERWRITERS LABORATORIES (UL)

UL 44	(1991; Rev thru Jan 1995) Rubber- Insulated Wires and Cables
UL 50	(1992) Enclosures for Electrical Equipment
UL 67	(1993; Rev thru May 1994) Panelboards
UL 489	(1991; Rev thru Dec 1994) Molded Case Circuit Breakers and Circuit Breaker Enclosures
UL 845	(1995) Motor Control Centers
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 1063	(1993; Rev thru Oct 1994) Machine-Tool Wires and Cables

## 1.2 SYSTEM DESCRIPTION

These specifications include the design, fabrication, assembly, wiring, testing, and delivery of the items of equipment and accessories and spare parts listed in the Schedule and shown on the drawings.

## 1.2.1 Rules

The equipment shall conform to the requirements of NFPA 70 unless more stringent requirements are indicated herein or shown. NEMA rated and UL listed equipment has been specified when available. Equipment must meet NEMA and UL construction and rating requirements as specified. No

equivalent will be acceptable. The contractor shall immediately notify the Contracting Officer of any requirements of the specifications or contractor proposed materials or assemblies that do not comply with UL or NEMA. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

#### 1.2.2 Coordination

The general arrangement of the motor control centers, switchboards and panelboards is shown on the contract drawings. Any modifications of the equipment arrangement or device requirements as shown on the drawings shall be subject to the approval of the Contracting Officer. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. All equipment shall be completely assembled at the factory. The motor control centers and switchboards may be disassembled into sections, if necessary, for convenience of handling, shipping, and installation.

#### 1.2.3 Standard Products

Material and equipment shall be standard products of a manufacturer regularly engaged in their manufacture and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials shall conform to the requirements of these specifications. Materials shall be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designated. All materials, supplies, and articles not manufactured by the Contractor shall be the products of other recognized reputable manufacturers. If the Contractor desires for any reason to deviate from the standards designated in these specifications, he shall, after award, submit a statement of the exact nature of the deviation, and shall submit, for the approval of the Contracting Officer, complete specifications for the materials which he proposes to use.

#### 1.2.4 Nameplates

Nameplates shall be made of laminated sheet plastic or of anodized aluminum approximately 1/8 inch thick, engraved to provide white letters on a black background. The nameplates shall be fastened to the panels in proper positions with anodized round-head screws. Lettering shall be minimum 1/2 inch high. Nameplate designations shall be in accordance with lists on the drawings, and as a minimum shall be provided for the following equipment:

- a. Motor Control Centers
- b. Individual items of equipment mounted in the Motor Control Centers
- c. Switchboards
- d. Individually-mounted circuit breakers in Switchboard
- e. Panelboards

Equipment of the withdrawal type shall be provided with nameplates mounted

on the removable equipment in locations visible when the equipment is in place.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Drawings; G  
Shop Drawings; G

The Contractor shall, within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of outline drawings of all equipment to be furnished under this contract, together with weights and overall dimensions. Drawings shall show the general arrangement and overall dimensions of the motor control centers, switchboards, and panelboards. These drawings shall show space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables.

Motor Control Centers; G

The Contractor shall, within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of electrical equipment drawings. The NEMA Class IIS motor control center drawings shall include a connection diagram with wire designations and schematic diagrams to illustrate operation of associated motor unit controls. An individual wiring diagram for each motor control center shall be submitted. Wiring diagrams shall be in a form showing physical arrangement of the control center with interconnecting wiring shown by lines or by terminal designations. A single-line diagram, equipment list and nameplate schedule shall be provided for each motor control center.

Switchboards; G  
Panelboards; G

The Contractor shall, within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of electrical equipment drawings. A single-line diagram, equipment list and nameplate schedule shall be provided for each switchboard and panelboard.

#### SD-03 Product Data

Equipment; G

The Contractor shall within 30 calendar days after date of award

submit for approval six (6) copies of such descriptive cuts and information as are required to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications. Data shall include descriptive data showing typical construction of the types of equipment proposed, including the manufacturer's name, type of molded case circuit breakers or motor circuit protectors, performance capacities and other information pertaining to the equipment. Six (6) sets of characteristic curves of the individual breaker trip element shall be submitted.

#### Factory Tests;

The Contractor shall submit, within a minimum of 14 days prior to the proposed date of tests, six (6) copies of manufacturer's routine factory test procedures and production line tests for all motor control centers and switchboards.

#### SD-06 Test Reports

##### Factory Tests;

The Contractor shall submit six (6) complete reproducible copies of the factory inspection results and six (6) complete reproducible copies of the factory test results in booklet form, including all plotted data curves, all test conditions, a listing of test equipment complete with calibration certifications, and all measurements taken. Report shall be signed and dated by the Contractor's and Contracting Officer's Representatives.

#### SD-07 Certificates

##### Motor Control Centers;

The contractor shall submit certification of factory test reports. Certification shall be signed by official authorized to certify on behalf of the manufacturer, attesting that the motor control center meets the specified requirements. The statement must be dated after the award of this contract, must state the Contractor's name and address, must name the project and location, and must list the specific requirements which are being certified.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

The equipment shall be shipped as completely assembled and wired as feasible so as to require a minimum of installation work. Each shipping section shall be properly match marked to facilitate reassembly, and shall be provided with removable lifting channels with eye bolts for attachment of crane slings to facilitate lifting and handling. Any relay or other device which cannot withstand the hazards of shipment when mounted in place on the equipment shall be carefully packed and shipped separately. These devices shall be marked with the number of the panel which they are to be mounted on and fully identified. All finished painted surfaces and metal work shall be wrapped suitably or otherwise protected from damage during

shipment. All parts shall be prepared for shipment so that slings for handling may be attached readily while the parts are in a railway car or transport truck. All spare parts and accessories shall be carefully packaged and clearly marked.

## 1.5 MAINTENANCE

### 1.5.1 Accessories and Tools

A complete set of accessories and special tools unique to equipment provided and required for erecting, handling, dismantling, testing and maintaining the apparatus shall be furnished by the Contractor.

## PART 2 PRODUCTS

### 2.1 CONNECTIONS

All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME B1.1. The sizes and threads of all conduit and fittings, tubing and fittings, and connecting equipment shall be in accordance with ASME B1.20.1. All ferrous fasteners shall have rust-resistant finish and all bolts and screws shall be equipped with approved locking devices. Manufacturer's standard threads and construction may be used on small items which, in the opinion of the Contracting Officer, are integrally replaceable, except that threads for external connections to these items shall meet the above requirements.

### 2.2 MOLDED CASE CIRCUIT BREAKERS

Molded case circuit breakers shall conform to the applicable requirements of NEMA AB 1 and UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be of automatic-trip type unless otherwise specified or indicated on the drawings. All poles of each breaker shall be operated simultaneously by means of a common handle. The operating handles shall clearly indicate whether the breakers are in "On," "Off," or "Tripped" position and shall have provisions for padlocking in the "Off" position. Personnel safety line terminal shields shall be provided for each breaker. The circuit breakers shall be products of only one manufacturer, and shall be interchangeable when of the same frame size.

#### 2.2.1 Trip Units

Except as otherwise noted, the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, shall be provided with combination thermal and instantaneous magnetic or solid state trip units. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval. The breaker trip units shall be interchangeable and the instantaneous magnetic trip units shall be adjustable on frame sizes larger than 150 amperes. Nonadjustable instantaneous magnetic trip units shall be set at approximately 10 times the continuous current ratings of the circuit breakers. Solid state trip units, where indicated, shall also have adjustable long time pick-up and delay, short time pick-up and

delay, and ground fault pick-up and delay.

#### 2.2.2 480-Volt AC Circuits

Circuit breakers for 480-volt or 277/480-volt ac circuits shall be rated 600 volts ac, and shall have an UL listed minimum interrupting capacity of 14,000, 42,000 symmetrical amperes at 600 volts ac.

#### 2.3 WIRING

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44 or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

#### 2.4 TERMINAL BLOCKS

Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600 volts. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. 10 in size and shall have sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal. The terminal arrangement shall be subject to the approval of the Contracting Officer and not less than four (4) spare terminals or 10 percent, whichever is greater, shall be provided on each block or group of blocks. Modular, pull apart, terminal blocks will be acceptable provided they are of the channel or rail-mounted type. The Contractor shall submit data showing that the proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

##### 2.4.1 Types of Terminal Blocks

###### 2.4.1.1 Short-Circuiting Type

Short-circuiting type terminal blocks shall be furnished for all current transformer secondary leads and shall have provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks shall meet the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.

###### 2.4.1.2 Load Type

Load terminal blocks rated not less than 600 volts and of adequate capacity shall be provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits except those for feeder tap units.

The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

#### 2.4.2 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

#### 2.5 MOTOR CONTROL CENTERS

Each motor control center shall be designed for operation on 480-volts ac, 3-phase, 60-Hz system, and the equipment shall conform to all the applicable requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 4 and NEMA ICS 6.

Vertical sections and individual units shall be listed and labeled under UL 845 where ever possible. In lieu of the UL listing, certification from any nationally recognized, adequately equipped, testing agency that the individual units and vertical sections have been tested and conform to the UL requirements of that agency will be acceptable when approved by the Contracting Officer. The motor control center shall be NEMA Class II, Type B or Type C motor control centers in accordance with NEMA ICS 2.

##### 2.5.1 Enclosures

Each motor control center shall consist of the required number of vertical sections of 90 inches nominal height, bolted together, with steel channel sills and suitable for mounting against a wall. Vertical section shall be 20 inches deep and buses, control wiring, control transformers, small power transformers, terminal blocks, line terminals, cable supports, and clamps shall be accessible from the front. Enclosure shall be NEMA Type 1 gasketed, 12, 3R. The control centers shall be fabricated from smooth select steel sheets shaped and reinforced to form rigid free-standing structures. Metal thickness for enclosures shall be not less than



specified in NEMA ICS 6 without exception. Vertical edges of sections exposed to view shall be so fabricated and bolted that the joints will not pass a 1/16 inch gage. Each structure shall be designed for addition of future sections required. Individual compartments shall be isolated from adjacent compartments.

#### 2.5.1.1 Unit Compartments

Each operating unit shall contain equipment as shown on the drawings, mounted in an individual cell. The unit assembly, except main circuit breakers, panelboards and auxiliary control devices, shall be drawout type removed from the front, without rear access or disturbing other units in the control center assembly. All drawout type unit assemblies shall have positive guide rail system to ensure alignment of connection to vertical bus. Units shall be mechanically interlocked with the door to prevent removal while in the energized position. Each removable unit shall have provision for padlocking in a position in which it is disconnected from the vertical bus although not removed from the stationary structure. All ventilating openings shall be provided with corrosion-resistant insect-proof screens on the inside. Bus closing plugs shall be provided for all unused openings in vertical bus barriers.

#### 2.5.1.2 Motor Control Center Doors and Covers

Each unit compartment, including blank compartments for future use, shall be provided with either a flange-formed or a rolled-edge door. Each door shall be mounted on fully-concealed or continuous full-length piano-type hinges and shall be provided with positive fasteners. Door sag shall be prevented by proper alignment of hinges made of sufficiently strong material. The door fastenings shall be so interlocked to prevent opening when the equipment is energized. The external operating handle shall clearly indicate whether the equipment is in an "ON", "OFF" or "TRIPPED" position.

#### 2.5.1.3 Horizontal Wireways

Structure shall have a minimum 12 inches high wireway at the top and a 6 inches minimum wireway at the bottom. Structure shall have a minimum 6 inches high wireway at the top and a 12 inches minimum wireway at the bottom. Both horizontal wireways shall run the length of the structure. A master terminal block compartment with full length wireway space shall be provided at the top or bottom where indicated in all Type C assemblies. Cover plates shall be provided on the side of the assembly to permit extension of the horizontal bus and wireway when vertical sections are added.

#### 2.5.1.4 Vertical Wireways

Vertical wireways shall be provided in all vertical sections accepting multiple plug-in components. Vertical wireways shall connect with horizontal wireways at the top and bottom and be a minimum 4 inches wide. Barriers shall be provided in sections containing both ac and dc vertical buses. Doors shall be provided on each vertical wireway. The exposed surface of any door shall not deviate more than 1/16 inch from a true plane.

#### 2.5.1.5 Sills

Channel iron foundations, complete with bolts and drilled holes for grouting and anchoring to the floor, shall be furnished for the complete length (front and rear) of each motor control center assembly. The channels shall be designed for flat mounting and maximum channel depth shall be 1-1/2 inches. Additional channel or substantial metal trim shall be provided flush with the end panels to completely enclose the bases across the ends of the equipment assemblies.

#### 2.5.1.6 Shutters

Drawout units shall have shutters which close when the unit is withdrawn to isolate the vertical bus.

#### 2.5.2 Buses

All buses shall be of copper and all bolted splices and connections between buses and for extensions or taps for equipment shall be tin or silver-plated. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187, and ASTM B 317. All splices for field assembly shall be bolted with at least two bolts and shall employ the use of "Belleville" washers in the connection. The bus ratings shall be based on a 65 degree Celsius maximum temperature rise in accordance with UL 845 requirements. Bus shall have a short-circuit current rating of not less than 42,000 RMS symmetrical amperes. All bus work shall be supported on wet process porcelain insulators, glass polyester, or suitable molded material.

##### 2.5.2.1 Horizontal Bus

Each control center assembly shall be provided with a three-phase main horizontal bus, with a continuous current rating not less than 600, 800, 1,000, 1,200 amperes, located across the top of each vertical section. The ends of horizontal buses shall be drilled for future extensions. The main horizontal bus shall be fully insulated.

##### 2.5.2.2 Vertical Bus

Each vertical section shall be provided with a three-phase vertical bus with a continuous current rating of 300, 600 amperes connected to the horizontal bus by brazing, welding, or bolting. Where the incoming feeder breakers are located at the bottom of a control center, the vertical bus in that section shall be rated the same as the main horizontal bus. Vertical buses shall extend from the horizontal bus to the bottom of the lowest available unit mounting space. The vertical bus shall be isolated from wireways and equipment in compartments.

##### 2.5.2.3 Ground Bus

A copper ground bus shall be provided full width at the bottom of the motor control center line-up. A full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable shall be provided at each

end of the bus for connection to the station grounding system.

### 2.5.3 Combination Starters

Combination motor controller units shall contain motor circuit protectors auxiliary and pilot devices and a magnetic contactor with thermal overload relays and reduced voltage starter where indicated on the drawings. The ratings of motor circuit protectors, contactors, motor controllers and other devices shall be as shown on the drawings. All combination motor controller units shall have short circuit ratings equal to 42,000 or greater. Where control push-buttons, indicating lamps, "Hand-Off-Automatic" switches, and similar control devices are associated with a unit, they shall be mounted on the unit compartment door. Door-mounted components shall not interfere with access within the compartments. Molded case circuit breakers for use in combination starters shall meet the requirements of paragraph MOLDED CASE CIRCUIT BREAKERS. Motor circuit protectors shall be only part of the combination starters as required by NFPA 70 and shall conform to all requirements of paragraph MOLDED CASE CIRCUIT BREAKERS, except that trip units shall have provision for locking the selected trip setting.

#### 2.5.3.1 Magnetic Contactors

Magnetic contactors shall be of the NEMA sizes indicated on the drawings. The rating, performance and service characteristics shall conform to the requirements of NEMA ICS 2 for contactors with continuous current ratings for the duty indicated. Contactors for motor control shall be rated for full-voltage starting (Class A controllers). Contactors shall be suitable for at least 200,000 complete operations under rated load without more than routine maintenance. The interruption arc and flame shall be minimized by suitable arc chutes or other means so that no damage will be done to other portions of the device. The arc chutes, if provided, shall be easily removable without removing or dismantling other parts. The contacts shall be easily removable. All current-carrying contact surfaces shall be silver-surfaced or of other approved material to prevent the formation of high resistance oxides. The contactor shall operate without chatter or perceptible hum while energized. Coils shall be suitable for continuous operation 120-volt ac circuits. Alternating-current contactors shall be three-pole, except where otherwise noted, and shall be insulated for 600 volts ac and of the electrically-operated, magnetically-held type. Direct-current contactors shall be two-pole, suitable for controlling circuits operating at 125 volts dc, insulated for 250 volts dc, electrically-operated, magnetically-held type and adequate for full-voltage motor starting service.

#### 2.5.3.2 Reduced Voltage Starters

Autotransformers shall be rated for medium duty and have taps according to NEMA ICS 2. For thermal over load protection, the autotransformer shall have normally closed thermostat wired in series with the normally closed thermal overload contact of the starter. Initial connection shall be to the 65 percent tap. Current transformers shall provide feedback signal to regulate torque during start up and to prevent overload conditions while motor is running. Starter shall have starting current of 300 percent of

full load amps for thirty seconds, bypass/isolation contactor, and three phase thermal overload relay.

#### 2.5.3.3 Auxiliary Contacts

Each controller shall be provided with a minimum of three auxiliary contacts which can be easily changed from normally open to normally closed.

Where indicated on the drawings, a fourth auxiliary contact and red and green indicating lights shall be provided.

#### 2.5.3.4 Overload Relays

Except as otherwise indicated, each controller shall be provided three NEMA Class 20 thermal overload relays with external manual reset. Prior to shipment of the control centers, the Contracting Officer will furnish the ratings of the heater elements to be installed in the relays by the Contractor.

#### 2.5.3.5 Individual Control Transformers

Where 120 volt ac control of contactors is indicated or required, individual control transformer shall be provided on the line side of the unit disconnect. The control transformers shall be rated 480-120 volts and shall conform to the requirements for control transformers in NEMA ST 1. Control transformers shall have adequate volt-ampere capacity for the control functions indicated. Transformers shall be installed with primary fuses. Primary fuses shall be Class J. Except as otherwise indicated on the drawings, each control transformer shall be provided with a fuse in one secondary lead and shall have the other secondary lead grounded.

#### 2.5.3.6 Voltage Fault Protection

Where shown, starters shall be provided with protection against voltage faults, phase unbalance, phase loss, phase reversal, undervoltage and overvoltage. Upon sensing one of these faults, the protector shall de-energize the starter. The protector shall use a combination of voltage and phase-angle sensing to detect phase loss even when regenerated voltages are present. The protector shall be connected to the load side of the motor circuit disconnect. The protector shall have an adjustable line voltage trip level, adjustable trip delay, automatic reset and manual reset by an external normally closed push-button, and Double Pull Double Throw (DPDT) output contacts. Protector operation shall have repeatability of +1 percent of set point, maximum, and a dead band of 2 percent maximum. Protector shall have green indicator to show normal status and red indicator to show tripped status. Indicators will be visible through the compartment door, when LED's are used protector shall be covered with a clear unbreakable cover, when lamps are used they shall have nameplates and be grouped with other indicating lights.

#### 2.5.3.7 Control Circuit Disconnects

Control circuit power shall disconnect when the unit compartment is opened.

#### 2.5.4 Molded Case Circuit Breakers in Unit Compartments

Molded case circuit breakers for installation in unit compartments shall meet the requirements of paragraph MOLDED CASE CIRCUIT BREAKERS above.

#### 2.5.5 Wiring for Motor Control Centers

All wiring shall meet the requirements of paragraph WIRING above. Heavy-duty clamp type terminals shall be provided by the Contractor for terminating all power cables entering the control centers.

##### 2.5.5.1 Contractor's Wiring

The Contractor's wiring shall be formed into groups, suitably bound together, properly supported and run straight horizontally or vertically. There shall be no splices in the wiring. The manufacturer's standard pressure-type wire terminations for connections to internal devices will be acceptable. Terminal blocks shall be added for wiring to devices having leads instead of terminals. Ring tongue indented terminals shall be used on all wires terminated on control terminal blocks for external or interpanel connections and at shipping splits. All stud terminals shall have contact nuts and either locking nuts or lockwashers.

##### 2.5.5.2 External Connections

Power and control cables will enter the control centers at the top.

##### 2.5.5.3 Terminal Blocks

Terminal blocks shall meet the requirements of paragraph TERMINAL BLOCKS above. In no case shall the terminals provided for circuit breakers or contactors accommodate less than the number or size of conductors shown on the drawings. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

#### 2.5.6 Control Transformers

Control transformers for several starter units shall be mounted in a separate compartment and its primary windings shall be connected to the main bus through a molded case circuit breaker of suitable rating. The control transformers shall be rated 480-120 volts and shall conform to the requirements for control transformers in NEMA ST 1. Control transformers shall have adequate volt-ampere capacity for the control functions indicated and an additional 10 percent capacity. Transformers shall be installed without primary fuses. Except as otherwise indicated on the drawings, each unit compartment shall provide a fuse for control power in one secondary lead and shall have the other secondary lead grounded. The unit disconnect shall be equipped with a normally open contact to isolate the control circuit from the source when the controller disconnect is open.

#### 2.5.7 Accessories and Control Devices

Control accessories shall be provided, and shall be suitable for mounting

on the front of, or inside, the control centers as indicated on the drawings. Control accessories shall meet the applicable requirements of NEMA ICS 2. Relays and other equipment shall be so mounted that mechanical vibration will not cause false operation.

#### 2.5.7.1 Control Stations

Push-button stations and selector switches shall conform to NEMA ICS 2, shall be of the heavy-duty, oil-tight type, rated 600 volts ac, and have a contact rating designation of A600. Switches shall be provided with escutcheon plates clearly marked to show operating positions.

#### 2.5.7.2 LED Indicating Lights

Red and green LED's shall be furnished where shown on the drawings, indicating contact "open" and "closed" position. The LED's shall be accessible and replaceable from the front of the control center through a finished opening in the compartment door. The LED assemblies shall be of the heavy duty oiltight, watertight, and dusttight type.

#### 2.5.7.3 Control Relays

Control relays shall be of the electrically operated, magnetically held, self-reset, open type, suitable for mounting inside the starter compartments, and shall be 125-volt dc or 120-volt ac. Contacts shall be as indicated on the drawings and shall have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2.

#### 2.5.7.4 Timing Relays

Timers shall be pneumatic type. They shall be suitable for mounting inside the control center and shall be rated 120 volts ac, 60 Hz. Instantaneous and time delay contacts shall be provided as indicated on the drawings, and shall have a contact rating designation of A600 or N600, as required, in accordance with NEMA ICS 2. Means shall be provided for manual adjustment over a range as indicated on the drawings.

### 2.6 SWITCHBOARDS

The switchboards shall be dead-front switchboards conforming to NEMA PB 2 and labeled under UL 891. The switchboards shall be completely enclosed self-supporting metal structures with the required number of vertical panel sections, buses, molded-case circuit breakers, and other devices as shown on the drawings. Switchboards shall be fully rated for a short-circuit current of 65,000 symmetrical amperes RMS AC.

#### 2.6.1 Enclosure

Each switchboard enclosure shall be NEMA type 2, built with selected smooth sheet steel panels of not less than No. 14 gage. Exposed panels on the front and ends shall have bent angle or channel edges with all corner seams welded and ground smooth. The front outside surfaces shall not be drilled or welded for the purpose of attaching wires or mounting devices if such holes or fastenings will be visible from the front. The front panels shall

be made in sections flanged on four sides and attached to the framework by screws and arranged for ready removal for inspection or maintenance. Ventilating openings shall be provided as required and shall preferably be of the grille type. All ventilating openings shall be provided with corrosion-resistant insect-proof screens on the inside. Switchboards shall be mounted as shown on the drawings and mounting materials shall be furnished by the Contractor as indicated. All interior and exterior steel parts shall be treated to inhibit corrosion and shall be painted as specified in paragraph PAINTING.

#### 2.6.2 Bus

All buses shall be of copper and all bolted splices and connections between buses and for extensions or taps for equipment shall be tin or silver-plated. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187, and ASTM B 317. All splices for field assembly shall be bolted with at least two bolts and shall employ the use of "Belleville" washers in the connection. Horizontal and vertical power buses have minimum current ratings as shown on the drawings. The buses shall be insulated for not less than 600 volts. Shop splices and tap connections shall be brazed, pressure-welded or bolted. All splices for field assembly shall be bolted. The buses shall be mounted on insulating supports of wet process porcelain, glass polyester, or suitable molded material, and shall be braced to withstand not less than 65,000 symmetrical amperes ac.

#### 2.6.3 Grounding Bus

A copper ground bus, rated not less than 300 amps, extending the entire length of the assembled structure, shall be mounted near the bottom of enclosure. A full clamp-type solderless copper or copper alloy lug for No. 2/0 AWG stranded copper cable shall be provided at each end of the bus for connection to the station grounding system.

#### 2.6.4 Components

Each switchboard shall be equipped with molded-case circuit breakers conforming to paragraph MOLDED CASE CIRCUIT BREAKERS and with frame sizes, trip ratings, and terminal connectors for attachment of outgoing power cables as shown on the drawings. The circuit breakers shall be individually stationary mounted, as shown on the drawings, and shall be operable and removable from the front. Where shown on the drawings, circuit breakers shall be enclosed in individual compartments. The group-mounted circuit breakers shall be provided complete with bus work in an integrated assembly on the switchboard and shall conform to the applicable requirements of paragraph PANELBOARDS.

#### 2.7 PANELBOARDS

Panelboards shall consist of assemblies of molded-case circuit breakers with buses and terminal lugs for the control and protection of branch circuits to motors, heating devices and other equipment operating at 480 volts ac or less. Panelboards shall be UL 67 labeled. "Loadcenter" type panels are not acceptable. Panelboards shall be designed for installation

in surface-mounted or flush-mounted cabinets accessible from the front only, as shown on the drawings. Panelboards shall be fully rated for a short-circuit current of 22,000 symmetrical amperes RMS ac.

#### 2.7.1 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than No 10 gage if flush-mounted or mounted outdoors, and not less than No 12 gage if surface-mounted indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Cabinets shall be painted in accordance with paragraph PAINTING. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 1/8 inch. Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 24 inches long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets. Enclosure shall have nameplates in accordance with paragraph NAMEPLATES. Directory holders, containing a neatly typed or printed directory under a transparent cover, shall be provided on the inside of panelboard doors.

#### 2.7.2 Buses

All panelboards shall be of the dead-front type with buses and circuit breakers mounted on a plate or base for installation as a unit in a cabinet. All buses shall be of copper. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187, and ASTM B 317. The sizes of buses and the details of panelboard construction shall meet or exceed the requirements of NEMA PB 1. Suitable provisions shall be made for mounting the bus within panelboards and adjusting their positions in the cabinets. Terminal lugs required to accommodate the conductor sizes shown on the drawing, shall be provided for all branch circuits larger than No. 10 AWG. A grounding lug suitable for 1/0 AWG wire shall be provided for each panelboard.

#### 2.7.3 Components

Each branch circuit, and the main buses where so specified or shown on the drawings, shall be equipped with molded-case circuit breakers having overcurrent trip ratings as shown on the drawings. The circuit breakers shall be of a type designed for bolted connection to buses in a panelboard assembly, and shall meet the requirements of paragraph MOLDED CASE CIRCUIT BREAKERS. Circuit breakers of the same frame size and rating shall be interchangeable. Bell alarm contacts shall be furnished as indicated on the drawings and shall be wired to terminal blocks mounted in the cabinet.



Terminal blocks shall conform to requirements of paragraph TERMINAL BLOCKS.

## 2.8 PAINTING

Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray. All touch-up work shall be done with manufacturer's coatings as supplied under paragraph SPARE PARTS.

## 2.9 FACTORY TESTS

Each item of equipment supplied under this contract shall be given the manufacturer's routine factory tests and tests as specified below, to insure successful operation of all parts of the assemblies. All tests required herein shall be witnessed by the Contracting Officer unless waived in writing, and no equipment shall be shipped until it has been approved for shipment by the Contracting Officer. The Contractor shall notify the Contracting Officer a minimum of 14 days prior to the proposed date of the tests so that arrangements can be made for the Contracting Officer to be present at the tests. The factory test equipment and the test methods used shall conform to the applicable NEMA Standards, and shall be subject to the approval of the Contracting Officer. Reports of all witnessed tests shall be signed by witnessing representatives of the Contractor and Contracting Officer. The cost of performing all tests shall be borne by the Contractor and shall be included in the prices bid in the schedule for equipment.

### 2.9.1 Motor Control Centers Tests

#### 2.9.1.1 Dielectric Tests

Each motor control center shall be completely assembled and given dielectric tests in accordance with NEMA ICS 1.

#### 2.9.1.2 Operational Tests

The correctness of operation of each air circuit breaker or motor circuit protector and magnetic contactor and of all control devices, accessories and indicating lamps, shall be checked. These checks shall be made at rated voltage with power supplies to the main buses. All magnetic contactors shall also be checked for proper operation with power at 90 percent of rated voltage.

#### 2.9.1.3 Short Circuit Tests

If the unit is not UL labeled for the specified short circuit, the contractor may submit design tests demonstrating that satisfactory short-circuit tests, as specified in NEMA ICS 2, have been made on a motor

control center of similar type of construction and having the same available short circuit current at the motor terminals, including any motor contributions, as the motor control centers specified to be furnished under these specifications.

#### 2.9.2 Switchboards Tests

##### 2.9.2.1 Production Tests

Each switchboard shall be completely assembled and given applicable production tests for assembled switchgear as specified in NEMA PB 2.

##### 2.9.2.2 Short Circuit Tests

If the unit is not UL labeled for the specified short circuit, the contractor may submit design tests demonstrating that satisfactory short-circuit tests have been made on a switchboard of similar type of construction and of the same short-circuit rating as the switchboards specified to be furnished under these specifications.

#### 2.9.3 Panelboards Tests

Each panelboard shall be assembled with cabinet and front to the extent necessary to check the fit and provisions for installing all parts in the field. Each panelboard shall be given a dielectric test in accordance with NEMA PB 1. All circuit breakers shall be operated to check mechanical adjustments. All doors and locks shall be checked for door clearances and fits and the performance of lock and latches.

#### PART 3 EXECUTION (Not Applicable)

-- End of Section --

## SECTION 16410A

AUTOMATIC TRANSFER SWITCH  
07/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117 (1997) Operating Salt Spray (Fog) Apparatus

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13 (1990; R 1995) Low-Voltage AC Power  
Circuit Breakers Used in Enclosures

IEEE C37.90.1 (1989; R 1994) IEEE Standard Surge  
Withstand Capability (SWC) Tests for  
Protective Relays and Relay Systems

IEEE C62.41 (1991; R 1995) Surge Voltages in  
Low-Voltage AC Power Circuits

IEEE Std 602 (1996) Electric Systems in Health Care  
Facilities

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (1993) Industrial Controls and Systems

NEMA ICS 2 (1993) Industrial Controls and Systems  
Controllers, Contactors, and Overload  
Relays Rated Not More Than 2,000 Volts AC  
or 750 Volts DC

NEMA ICS 4 (1997) Industrial Control and Systems  
Terminal Blocks

NEMA ICS 6 (1993) Industrial Control and Systems,  
Enclosures

NEMA ICS 10 (1999) Industrial Control and Systems: AC  
Transfer Switch Equipment - Part 2:  
Static AC Transfer Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code  
NFPA 110 (1999) Emergency and Standby Power Systems

UNDERWRITERS LABORATORIES (UL)

UL 1008 (1996; Rev thru Feb 1999) Transfer Switch  
Equipment  
UL 1066 (1997) Low-Voltage AC and DC Power Circuit  
Breakers Used in Enclosures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switches;

Schematic, external connection, one-line schematic and wiring diagram of each ATS assembly. Interface equipment connection diagram showing conduit and wiring between ATS and related equipment. Device, nameplate, and item numbers shown in list of equipment and material shall appear on drawings wherever that item appears. Diagrams shall show interlocking provisions and cautionary notes, if any. Operating instructions shall be shown either on one-line diagram or separately. Unless otherwise approved, one-line and elementary or schematic diagrams shall appear on same drawing.

Equipment;  
Installation;

Dimensioned plans, sections and elevations showing minimum clearances, weights, and conduit entry provisions for each ATS.

SD-03 Product Data

Material;  
Equipment;

List of proposed equipment and material, containing a description of each separate item.

SD-06 Test Reports

Testing; G

A description of proposed field test procedures, including proposed date and steps describing each test, its duration and expected results, not less than 2 weeks prior to test date.

Certified factory and field test reports, within 14 days following completion of tests. Reports shall be certified and dated and shall demonstrate that tests were successfully completed prior to shipment of equipment.

#### SD-07 Certificates

Equipment;  
Material;

Certificates of compliance showing evidence of UL listing and conformance with applicable NEMA standards. Such certificates are not required if manufacturer's published data, submitted and approved, reflect UL listing or conformance with applicable NEMA standards.

Switching Equipment;

Evidence that ATS withstand current rating (WCR) has been coordinated with upstream protective devices as required by UL 1008. Upon request, manufacturer shall also provide notarized letter certifying compliance with requirements of this specification, including withstand current rating.

#### SD-10 Operation and Maintenance Data

Switching Equipment;  
Instructions;

Six copies of operating manual outlining step-by-step procedures for system startup, operation, and shutdown. Manual shall include manufacturer's name, model number, service manual, parts list, and brief description of equipment and basic operating features. Manufacturer's spare parts data shall be included with supply source and current cost of recommended spare parts. Six copies of maintenance manual listing routine maintenance, possible breakdowns, repairs, and troubleshooting guide. Manual shall include simplified wiring and control diagrams for system as installed.

### 1.3 GENERAL REQUIREMENTS

#### 1.3.1 Standard Product

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience use shall include applications in similar circumstances and of same design and rating as specified ATS.

Equipment shall be capable of being serviced by a manufacturer-authorized and trained organization that is, in the Contracting Officer's opinion, reasonably convenient to the site.

#### 1.3.2 Nameplate

Nameplate showing manufacturer's name and equipment ratings shall be made of corrosion-resistant material with not less than 1/8 inch tall characters. Nameplate shall be mounted to front of enclosure and shall comply with nameplate requirements of NEMA ICS 2.

### PART 2 PRODUCTS

#### 2.1 AUTOMATIC TRANSFER SWITCH (ATS)

ATS shall be electrically operated and mechanically held in both operating positions. ATS shall be suitable for use in emergency systems or standby systems described in NFPA 70. ATS shall be UL listed. ATS shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, IEEE C37.13, IEEE C62.41, IEEE Std 602, NEMA ICS 1, NEMA ICS 2, NEMA ICS 10, UL 1008 and UL 1066. ATS shall conform to NFPA 110. To facilitate maintenance, manufacturer's instruction manual shall provide typical maximum contact voltage drop readings under specified conditions for use during periodic maintenance. Manufacturer shall provide instructions for determination of contact integrity. ATS shall be rated for continuous duty at specified continuous current rating. ATS shall be fully compatible and approved for use with BP/IS specified. BP/IS shall be considered part of ATS system. ATS shall have following characteristics:

- a. Voltage: 277/480 volts ac.
- b. Number of Phases: Three.
- c. Number of Wires: Four.
- d. Frequency: 50 Hz.
- e. Poles: Four switched and switched neutral overlapping contacts.
- f. ATS WCR: Rated to withstand short-circuit current of 42,000 amperes, RMS symmetrical.
- g. Nonwelding Contacts: Rated for nonwelding of contacts when used with upstream feeder overcurrent devices shown and with available fault current specified.
- h. Main Contacts: Contacts shall have silver alloy composition. Neutral contacts shall have same continuous current rating as main or phase contacts. Neutral contact continuous current rating shall be not less than twice the rating of main or phase contacts.

##### 2.1.1 Override Time Delay

Time delay to override monitored source deviation shall be adjustable from

0.5 to 6 seconds and factory set at 1 second. ATS shall monitor phase conductors to detect and respond to sustained voltage drop of 15 percent of nominal between any two normal source conductors and initiate transfer action to emergency source and start engine driven generator after set time period. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Dropout voltage shall be adjustable from 75 to 98 percent of pickup value and factory set at 85 percent of nominal.

#### 2.1.2 Transfer Time Delay

Time delay before transfer to emergency power source shall be adjustable from 0 to 5 minutes and factory set at 0 minutes. ATS shall monitor frequency and voltage of alternate or emergency power source and transfer when frequency and voltage are stabilized. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent.

Pickup frequency shall be adjustable from 90 to 100 percent of nominal and factory set at 90 percent.

#### 2.1.3 Return Time Delay

Time delay before return transfer to normal power source shall be adjustable from 0 to 30 minutes and factory set at 30 minutes. Time delay shall be automatically defeated upon loss or sustained undervoltage of emergency power source, provided that normal supply has been restored.

#### 2.1.4 Engine Shutdown Time Delay

Time delay shall be adjustable from 0 to 30 minutes and shall be factory set at 10 minutes.

#### 2.1.5 Exerciser

Provide a generator exerciser timer. Run times shall be user programmable.

The generator exerciser shall be selectable between load transfer and engine run only, and shall have a fail-safe feature that will retransfer the ATS to normal or preferred during the exercise period.

#### 2.1.6 Auxiliary Contacts

Two normally open and two normally closed auxiliary contacts rated at 15 amperes at 120 volts shall operate when ATS is connected to normal power source, and two normally open and two normally closed contacts shall operate when ATS is connected to alternate or emergency source.

#### 2.1.7 Supplemental Features

ATS shall be furnished with the following:

- a. Engine start contact.
- b. Emergency source monitor.
- c. Test switch to simulate normal power outage.

- d. Voltage sensing. Pickup voltage adjustable from 85 to 100 percent of nominal; dropout adjustable from 75 to 98 percent of pickup.
- e. Time delay bypass switch to override return time delay to normal.
- f. Manual return-to-normal switch.
- g. Means shall be provided in the ATS to insure that motor/transformer load inrush currents do not exceed normal starting currents. This shall be accomplished with either in-phase monitoring, time-delay transition, or load voltage decay sensing methods. If manufacturer supplies an in-phase monitoring system, the manufacturer shall indicate under what conditions a transfer cannot be accomplished. If the manufacturer supplies a time-delay transition system, the manufacturer shall supply recommendations for establishing time delay. If load voltage decay sensing is supplied, the load voltage setting shall be user programmable.

#### 2.1.8 Operator

Manual operator conforming to UL 1008 shall be provided, and shall incorporate features to prevent operation by unauthorized personnel. ATS shall be designed for safe manual operation under full load conditions. If manual operation is accomplished by opening the door, then a dead-front shall be supplied for operator safety.

#### 2.1.9 Override Switch

Override switch shall bypass automatic transfer controls so ATS will transfer and remain connected to alternate or emergency power source, regardless of condition of normal or preferred source. If alternate or emergency source fails and normal or preferred source is available, ATS shall automatically retransfer to normal or preferred source.

#### 2.1.10 Green Indicating Light

A green indicating light shall supervise/provide normal or preferred power source switch position indication and shall have a nameplate engraved NORMAL or PREFERRED.

#### 2.1.11 Red Indicating Light

A red indicating light shall supervise/provide alternate or emergency power source switch position indication and shall have a nameplate engraved ALTERNATE or EMERGENCY.

### 2.2 ENCLOSURE

ATS and accessories shall be installed in wall-mounted or free-standing, floor-mounted, ventilated NEMA ICS 6, Type 1 smooth sheet metal enclosure constructed in accordance with applicable requirements of UL 1066 and/or UL 1008. Door shall have suitable hinges, locking handle latch, and gasketed



jamb. Metal gauge shall be not less than No. 14. Enclosure shall be equipped with at least two approved grounding lugs for grounding enclosure to facility ground system using No. 4 AWG copper conductors. Factory wiring within enclosure and field wiring terminating within enclosure shall comply with NFPA 70. If wiring is not color coded, wire shall be permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing. Terminal block shall conform to NEMA ICS 4. Terminals shall be arranged for entrance of external conductors from top of enclosure as shown. Main switch terminals, including neutral terminal if used, shall be pressure type suitable for termination of external copper conductors shown.

#### 2.2.1 Construction

Enclosure shall be constructed for ease of removal and replacement of ATS components and control devices from front without disconnection of external power conductors or removal or disassembly of major components. Enclosure of ATS with BP/IS shall be constructed to protect personnel from energized BP/IS components during ATS maintenance.

#### 2.2.2 Cleaning and Painting

Both the inside and outside surfaces of an enclosure, including means for fastening, shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Finish shall be manufacturer's standard material, process, and color and shall be free from runs, sags, peeling, or other defects. An enclosure marked Type 1 shall be acceptable if there is no visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B 117, employing a 5 percent by weight, salt solution for 24 hours.

### 2.3 TESTING

#### 2.3.1 Factory Testing

A prototype of specified ATS shall be factory tested in accordance with UL 1008. In addition, factory tests shall be performed on each ATS as follows:

- a. Insulation resistance test to ensure integrity and continuity of entire system.
- b. Main switch contact resistance test.
- c. Visual inspection to verify that each ATS is as specified.
- d. Mechanical test to verify that ATS sections are free of mechanical hindrances.
- e. Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.

### 2.3.2 Factory Test Reports

Manufacturer shall provide three certified copies of factory test reports.

### 2.4 Viewing Ports

ATS and BP/IS switches shall be of draw-out construction. Viewing ports to inspect the contacts without requiring disassembly shall be provided.

### 2.5 Operating Handles

The operating handles shall be externally operated, and designed and constructed not to stop in an intermediate or neutral position during operation, but shall permit load by-pass and transfer switch isolation in no more than two manual operations which can be performed by one person in 5 seconds or less. The transfer speed will be independent of the operational speed of the switch handle or handles.

## PART 3 EXECUTION

### 3.1 INSTALLATION

ATS shall be installed as shown and in accordance with approved manufacturer's instructions.

### 3.2 INSTRUCTIONS

Manufacturer's approved operating instructions shall be permanently secured to cabinet where operator can see them. One-line and elementary or schematic diagram shall be permanently secured to inside of front enclosure door.

### 3.3 SITE TESTING

Following completion of ATS installation and after making proper adjustments and settings, site tests shall be performed in accordance with manufacturer's written instructions to demonstrate that each ATS functions satisfactorily and as specified. Contractor shall advise Contracting Officer not less than 5 working days prior to scheduled date for site testing, and shall provide certified field test reports within 2 calendar weeks following successful completion of site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:

- a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.
- b. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
- c. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five

times.

- d. Low phase-to-ground voltage shall be simulated for each phase of normal source.
- e. Operation and settings shall be verified for specified ATS features, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
- f. Manual and automatic ATS and BP/IS functions shall be verified.

-- End of Section --

## SECTION 16415A

ELECTRICAL WORK, INTERIOR  
**06/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	(1995) Code for Electricity Metering
ANSI C12.10	(1997) Electromechanical Watthour Meters
ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C12.4	(1984; R 1996) Mechanical Demand Registers
ANSI C135.30	(1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction
ANSI C37.16	(2000) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C57.12.10	(1988) Safety Requirements for Transformers 230 kV and Below 833/958 Through 8333/10417 kVA, Single-Phase, and 750/862 Through 60 000/80 000/ 100 000 kVA, Three-Phase Without Load Tap Charging; and 3750/4687 Through 60 000/80 000/100/000 kVA With Load Tap Charging
ANSI C57.12.13	(1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations
ANSI C57.12.27	(1982) Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations

ANSI C57.12.50	(1981; R 1989) Ventilated Dry-Type Distribution Transformers 1 to 500 kVA, Single-Phase; and 15 to 500 kVA, Three-Phase with High-Voltage 601 to 34 500 Volts, Low-Voltage 120 to 600 Volts
ANSI C57.12.51	(1981; R 1989) Ventilated Dry-Type Power Transformers, 501 kVA and Larger, Three-Phase, with High-Voltage 601 to 34 500 Volts, Low-Voltage 208Y/120 to 4160 Volts
ANSI C57.12.52	(1981; R 1989) Sealed Dry-Type Power Transformers, 501 kVA and Larger, Three-Phase with High-Voltage 601 to 34 500 Volts, Low-Voltage 208Y/120 to 4160 Volts
ANSI C57.12.70	(1978; R 1993) Terminal Markings and Connections for Distribution and Power Transformers
ANSI C78.1	(1991; C78.1a; R 1996) Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
ANSI C78.1350	(1990) Electric Lamps - 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1351	(1989) Electric Lamps - 250-Watt, 100-Volt S50 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1352	(1990) Electric Lamps - 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1355	(1989) Electric Lamps - 150-Watt, 55-Volt S55 High-Pressure Sodium Lamps
ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Metal-Halide Lamps
ANSI C78.20	(1995) Electric Lamps - Characteristics of Incandescent Lamps A, G, PS, and Similar Shapes with E26 Medium Screw Bases
ANSI C78.21	(1995) Physical and Electrical Characteristics - Incandescent Lamps - PAR and R Shapes

ANSI C78.2A	(1991) 18 & 26- Watt, Compact Fluorescent Quad Tube Lamps **
ANSI C78.2B	(1992) 9 & 13-Watt, Compact Fluorescent Quad Tube Lamps **
ANSI C80.5	(1995) Rigid Aluminum Conduit
ANSI C82.1	(1997) Specifications for Fluorescent Lamp Ballasts \\\\$18.00\$\\F\\X Addenda D & E
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
ASTM D 709	(2000) Laminated Thermosetting Materials

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C57.100	(1999) Test Procedure for Thermal Evaluation of Oil-Immersed Distribution Transformers \\\\$avail only as part of Distribution, Power, and Regulating Transformers Stds Collection
IEEE C57.12.00	(1993) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.80	(1996) Terminology for Power and Distribution Transformers \\\\$avail only as part of Distribution, Power, and Regulating Transformer Stds Collection
IEEE C57.12.90	1999) Test Code for Liquid-Immersed

Distribution, Power, and Regulating  
Transformers and Guide for Short-Circuit  
Testing of Distribution and Power  
Transformers \\\\$avail only as part of  
Distribution, Power, and Regulating  
Transformers Stds Collection

IEEE C57.13	(1993) Instrument Transformers
IEEE C57.98	(1993) Guide for Transformer Impulse Tests \\\$avail only as part of Distribution, Power, and Regulating Transformers Stds Collection
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) \\\\$31.00\$\\F

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA BU 1	(1994) Busways
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures

NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	(1998) Motors and Generators
NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1998) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA PB 1	(1995) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA PE 5	(1996) Utility Type Battery Chargers
NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA SG 3	(1995) Power Switching Equipment
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 13	(1993) Electrical Nonmetallic Tubing (ENT)
NEMA TC 2	(1998) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA VE 1	(1996) Metal Cable Tray Systems
NEMA WD 1	(1999) General Requirements for Wiring Devices
NEMA WD 6	(1997) Wiring Devices - Dimensional Requirements

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Life Safety Code
NFPA 70	(2002) National Electrical Code

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 18	Industrial, Scientific, and Medical Equipment
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## UNDERWRITERS LABORATORIES (UL)

UL 1	(2000) Flexible Metal Conduit
UL 1004	(1994; Rev thru Nov 1999) Electric Motors
UL 1010	(1995; Rev thru Mar 1999) Receptical-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1022	(1998) Line Isolation Monitors
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1047	(1995; Rev Jul 1998) Isolated Power Systems Equipment
UL 1236	(1994; Rev thru Mar 1999) Battery Chargers for Charging Engine-Starter Batteries
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1449	(1996; Rev thru Dec 1999) Transient Voltage Surge Suppressors
UL 1564	(1993; R Sep 1998) Industrial Battery Chargers
UL 1569	(1999; Rev thru Jan 2000) Metal-Clad Cables
UL 1570	(1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures
UL 1571	(1995; Rev thru Nov 1999) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Nov 1999) High Intensity Discharge Lighting Fixtures
UL 1660	(2000) Liquid-Tight Flexible Nonmetallic Conduit
UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev thru Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses

UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 198H	(1988; Rev thru Nov 1993) Class T Fuses
UL 198L	(1995; Rev May 1995) D-C Fuses for Industrial Use
UL 20	(1995; Rev thru Oct 1998) General-Use Snap Switches
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 4	(1996) Armored Cable
UL 44	(1999) Thermoset-Insulated Wires and Cables
UL 467	(1993; Rev thru Apr 1999) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 486C	(1997; Rev thru Aug 1998) Splicing Wire Connectors
UL 486E	(1994; Rev thru Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996; Rev thru Jan 1999) Attachment Plugs and Receptacles
UL 5	(1996) Surface Metal Raceways and Fittings
UL 50	(1995; Rev thru Nov 1999) Enclosures for Electrical Equipment
UL 506	(1994; R Oct 1997) Specialty Transformers
UL 508	(1999) Industrial Control Equipment
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

UL 512	(1993; Rev thru Mar 1999) Fuseholders
UL 514A	(1996; Rev Dec 1999) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 514C	(1996; Rev thru Dec 1999) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1999) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 6	(1997) Rigid Metal Conduit
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev thru Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 67	(1993; Rev thru Oct 1999) Panelboards
UL 674	(1994; Rev thru Oct 1998) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	(1995; Rev thru Mar 1999) Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL 719	(1996; Rev Jul 1999) Nonmetallic-Sheathed Cables
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 817	(1994; Rev thru May 1999) Cord Sets and Power-
UL 83	(1998; Rev thru Sep 1999) Thermoplastic-Insulated Wires and Cables
UL 844	(1995; Rev thru Mar 1999) Electric Lighting Fixtures for Use in Hazardous (Classified) Locations
UL 845	(1995; Rev thru Nov 1999) Motor Control Centers
UL 854	(1996; Rev Oct 1999) Service-Entrance Cables

UL 857	(1994; Rev thru Dec 1999) Busways and Associated Fittings
UL 869A	(1998) Reference Standard for Service Equipment
UL 877	(1993; Rev thru Nov 1999) Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	(1994; Rev thru Apr 1999) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 891	(1994; Rev thru Jan 1995) Dead-Front Switchboards
UL 916	(1998) Energy Management Equipment
UL 924	(1995; Rev thru Oct 97) Emergency Lighting and Power Equipment
UL 935	(1995; Rev thru Oct 1998) Fluorescent-Lamp Ballasts
UL 943	(1993; Rev thru May 1998) Ground-Fault Circuit-Interrupters
UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches
UL Elec Const Dir	(1999) Electrical Construction Equipment Directory

## 1.2 GENERAL

### 1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

### 1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible.

Lighting fixtures, outlets, and other equipment and materials shall be carefully coordinated with mechanical or structural features prior to installation and positioned according to architectural reflected ceiling plans; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown.

Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate the electrical requirements of the mechanical work and provide all power related circuits, wiring, hardware and structural support, even if not shown on the drawings.

#### 1.2.3 Special Environments

##### 1.2.3.1 Weatherproof Locations

Wiring, Fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

##### 1.2.3.2 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70 unless more stringent requirements are indicated in this specification or on the contract drawings.

#### 1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

#### 1.2.5 Nameplates

##### 1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 1/4 inch  
High Letters

Minimum 1/8 inch  
High Letters

Panelboards  
Starters  
Safety Switches  
Motor Control Centers  
Transformers  
Equipment Enclosures  
Switchboards  
Motors

Control Power Transformers  
Control Devices  
Instrument Transformers

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

#### 1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

###### Interior Electrical Equipment; .

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission.

Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned.

Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

- a. Transformers.
- b. Motors and rotating machinery.
- c. Motor control centers.
- d. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

#### SD-03 Product Data

Fault Current and Protective Device Coordination Study; .

The study shall be submitted along with protective device equipment submittals. No time extensions or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices

proposed shall be based on recommendations of this study, The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog; .

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; .

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures; .

Installation procedures for rotating equipment, transformers, battery systems, and grounding resistors. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

As-Built Drawings; .

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction.

The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

Onsite Tests; G.

A detailed description of the Contractor's proposed procedures for on-site tests.



## SD-06 Test Reports

## Factory Test Reports; G.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.

## Field Test Plan; G.

A detailed description of the Contractor's proposed procedures for onsite test submitted 20 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

## Field Test Reports; G.

Six copies of the information described below in 8 1/2 x 11 inch binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.

g. A description of adjustments made.

h. Final position of controls and device settings.

#### SD-07 Certificates

##### Materials and Equipment; .

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

#### 1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

#### PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

##### 2.1 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper.

### 2.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

### 2.1.2 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83 or RHW conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

### 2.1.3 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

### 2.1.4 Service Entrance Cables

Service entrance (SE) and underground service entrance (USE) cables, UL 854.

### 2.1.5 Metal-Clad Cable

UL 1569; NFPA 70, Type MC cable.

## 2.2 TRANSIENT VOLTAGE SURGE PROTECTION

Transient voltage surge suppressors shall be provided as indicated. Surge suppressors shall meet the requirements of IEEE C62.41 and be UL listed and labeled as having been tested in accordance with UL 1449. Surge suppressor ratings shall be 120/208 or 277/480 volts rms, operating voltage; 60 Hz; 3-phase; 4 wire with ground; transient suppression voltage (peak let-through voltage) of 1000 volts. Fuses shall not be used as surge suppression.

## 2.3 CIRCUIT BREAKERS

### 2.3.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

#### 2.3.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with

not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

#### 2.3.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

#### 2.3.1.3 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.

#### 2.3.2 Solid-State Trip Elements

Solid-state circuit breakers shall be provided as shown. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-state sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13th harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be torodial construction, encased in a plastic housing filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as shown on the drawings and as described below:

- a. Long-time current pick-up, adjustable from 50 percent to 100 percent of continuous current rating.
- b. Adjustable long-time delay.

- c. Short-time current pick-up, adjustable from 1.5 to 9 times long-time current setting.
- d. Adjustable short-time delay.
- e. Instantaneous current pick-up, adjustable from 1.5 to 9 times long-time current setting.
- f. Ground-fault pick-up, adjustable from 20 percent to 60 percent of sensor rating, but not greater than 1200 amperes. Sensing of ground-fault current at the main bonding jumper or ground strap will not be permitted. Zone-selective interlocking shall be provided as shown.
- g. Adjustable ground-fault delay.
- h. Ground-fault  $I^2 t$  switch.
- i. Overload, short-time and ground-fault trip indicators shall be provided.

#### 2.3.3 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

#### 2.3.4 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

#### 2.4 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors shall conform to UL 508 and shall be provided in and used only as part of a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection, and shall be rated in accordance with the requirements of NFPA 70.

##### 2.4.1 Construction

Motor short-circuit protector bodies shall be constructed of high temperature, dimensionally stable, long life, nonhygroscopic materials. Protectors shall fit special MSCP mounting clips and shall not be interchangeable with any commercially available fuses. Protectors shall have 100 percent one-way interchangeability within the A-Y letter designations. All ratings shall be clearly visible.

##### 2.4.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage.

Letter designations shall be A through Y for motor controller Sizes 0, 1, 2, 3, 4, and 5, with 100,000 amperes interrupting capacity rating. Letter designations shall correspond to controller sizes as follows:

CONTROLLER SIZE	MSCP DESIGNATION
NEMA 0	A-N
NEMA 1	A-P
NEMA 2	A-S
NEMA 3	A-U
NEMA 4	A-W
NEMA 5	A-Y

## 2.5 CONDUIT AND TUBING

### 2.5.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

### 2.5.2 Flexible Conduit, Steel

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

### 2.5.3 Intermediate Metal Conduit

UL 1242.

### 2.5.4 Rigid Metal Conduit

UL 6.

### 2.5.5 Rigid Plastic Conduit

NEMA TC 2, UL 651 and UL 651A.

### 2.5.6 Surface Metal Electrical Raceways and Fittings

UL 5.

## 2.6 CONDUIT AND DEVICE BOXES AND FITTINGS

### 2.6.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

### 2.6.2 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.6.3 Fittings for Conduit and Outlet Boxes

UL 514B.

2.6.4 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.7 CONNECTORS, WIRE PRESSURE

2.7.1 For Use With Copper Conductors

UL 486A.

2.8 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.8.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 3/4 inch in diameter by 10 feet in length of the sectional type driven full length into the earth.

2.8.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.9 ENCLOSURES

NEMA ICS 6 or NEMA 250 unless otherwise specified.

2.9.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 100 cubic inches shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.9.2 Circuit Breaker Enclosures

UL 489.

2.10 LIGHTING FIXTURES, LAMPS, BALLASTS, CONTROLS AND ACCESSORIES

The following specifications are supported and supplemented by information and details on the drawings. Additional fixtures, if shown, shall conform to this specification. Lamps, lampholders, ballasts, transformers, electronic circuitry and other lighting system components shall be constructed according to industry standards. Equipment shall be tested and listed by a recognized independent testing laboratory for the expected installation conditions. Equipment shall conform to the standards listed below.

## 2.10.1 Lamps

Lamps shall be constructed to operate in the specified fixture, and shall function without derating life or output as listed in published data.

Lamps shall meet the requirements of the Energy Policy Act of 1992.

- a. Incandescent and tungsten halogen lamps shall be designed for 125 volt operation (except for low voltage lamps), shall be rated for minimum life of 2,000 hours, and shall have color temperature between 2,800 and 3,200 degrees Kelvin. Tungsten halogen lamps shall incorporate quartz capsule construction. Lamps shall comply with ANSI C78.20 and sections 238 and 270 of ANSI C78.21.
- b. Fluorescent lamps shall be green-tipped and shall have color temperature of 3,500 degrees Kelvin. They shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used. Fluorescent lamps, including spares, shall be manufactured by one manufacturer to provide for color and performance consistency. Fluorescent lamps shall comply with ANSI C78.1. Fluorescent tube lamp efficiencies shall meet or exceed the following requirements.

T8, 32 watts

(4' lamp)

2800 lumens

(1) Linear fluorescent lamps, unless otherwise indicated, shall be 4 feet long 32 watt T8, 265 mA, with minimum CRI of 75. Lamps of other lengths or types shall be used only where specified or shown. Lamps shall deliver rated life when operated on rapid start ballasts.

(2) Small compact fluorescent lamps shall be twin, double, or triple tube configuration as shown with bi-pin or four-pin snap-in base and shall have minimum CRI of 85. They shall deliver rated life when operated on ballasts as shown. 9 and 13 watt double tube lamps shall comply with ANSI C78.2B. 18 and 26 watt double tube lamps shall comply with ANSI C78.2A. Minimum starting temperature shall be 32 degrees F for twin tube lamps and for double and triple twin tube lamps without internal starter; and 15 degrees F for double and triple twin tube lamps with internal starter.

- c. High intensity discharge lamps, including spares, shall be manufactured by one manufacturer in order to provide color and performance consistency. High intensity discharge lamps shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used and shall have wattage, shape and base as shown. High intensity discharge lamps, unless otherwise shown, shall have medium or mogul screw base and minimum starting temperature of -20 degrees F. Metal halide lamps, unless otherwise shown, shall have minimum CRI of 65; color temperature of 4,300 degrees Kelvin; shall be -BU configuration if used in base-up position; and shall be -H or high output configuration if used in horizontal position. Lamps shall comply with all



applicable ANSI C78.1350, ANSI C78.1351, ANSI C78.1352, ANSI C78.1355, ANSI C78.1375, and ANSI C78.1376.

#### 2.10.2 Ballasts and Transformers

Ballasts or transformers shall be designed to operate the designated lamps within their optimum specifications, without derating the lamps. Lamp and ballast combinations shall be certified as acceptable by the lamp manufacturer.

- a. Fluorescent ballasts shall comply with ANSI C82.1 and shall be mounted integrally within fluorescent fixture housing unless otherwise shown. Ballasts shall have maximum current crest factor of 1.7; high power factor; Class A sound rating; maximum operating case temperature of 77 degrees F above ambient; and shall be rated Class P. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture. A single ballast may be used to serve multiple fixtures if they are continuously mounted, identically controlled and factory manufactured for that installation with an integral wireway.

(1) Compact fluorescent ballasts shall comply with IEEE C62.41 Category A transient voltage variation requirements and shall be mounted integrally within compact fluorescent fixture housing unless otherwise shown. Ballasts shall have minimum ballast factor of 0.95; maximum current crest factor of 1.6; high power factor; maximum operating case temperature of 77 degrees F above ambient; shall be rated Class P; and shall have a sound rating of Class A. Ballasts shall meet FCC Class A specifications for EMI/RFI emissions. Ballasts shall operate from nominal line voltage of 120 or 277 volts at 60 Hz and maintain constant light output over a line voltage variation of  $\pm 10\%$ . Ballasts shall have an end-of-lamp-life detection and shut-down circuit. Ballasts shall be UL listed and shall contain no PCBs. Ballasts shall contain potting to secure PC board, provide lead strain relief, and provide a moisture barrier.

(2) Electronic fluorescent ballasts shall comply with 47 CFR 18 for electromagnetic interference. Ballasts shall withstand line transients per IEEE C62.41, Category A. Ballasts shall have total harmonic distortion between 10 and 20%; minimum frequency of 20,000Hz; filament voltage between 2.5 and 4.5 volts; maximum starting inrush current of 20 amperes; and shall comply with the minimum Ballast Efficacy Factors shown in the table below. Minimum starting temperature shall be 50 degrees F.

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years for the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using

Government facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

#### ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL VOLTAGE	NUMBER OF LAMPS	MINIMUM BALLAST EFFICACY FACTOR
32W T8	rapid	120 or 277 V	1	2.54
	start		2	1.44
	linear &		3	0.93
	U-tubes		4	0.73

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(3) Dimming compact fluorescent ballasts shall be electronic and shall comply with the applicable compact fluorescent and dimming ballast specifications shown above. Ballasts shall operate the lamps shown in the range from full rated light output to 5 percent of full rated light output. Ballast power factor shall be <90% throughout dimming range. THD shall be <10% at maximum light output and <20% at minimum light output. Ballast shall ignite the lamps at any light output setting selected.

- c. High intensity discharge ballasts shall comply with UL 1029 and, if multiple supply types, with ANSI C82.4. Ballasts shall have minimum ballast factor of 0.9; high power factor; Class A sound rating; and maximum operating case temperature of 77 degrees F above ambient.

(1) Electronic high intensity discharge ballasts shall be constant wattage autotransformer type; shall have less than 10% ballast loss; shall have total harmonic distortion between 10 and 20%; and shall have a minimum starting temperature of 0 degrees F.

(2) Magnetic high intensity discharge ballasts shall have a minimum starting temperature of -20 degrees F.

#### 2.10.3 Fixtures

Fixtures shall be in accordance with the size, shape, appearance, finish, and performance shown. Unless otherwise indicated, lighting fixtures shall be provided with housings, junction boxes, wiring, lampholders, mounting supports, trim, hardware and accessories for a complete and operable installation. Recessed housings shall be minimum 20 gauge cold rolled or galvanized steel as shown. Extruded aluminum fixtures shall have minimum wall thickness of 0.125 inches. Plastic lenses shall be 100% virgin acrylic or as shown. Glass lenses shall be tempered. Heat resistant glass shall be borosilicate type. Conoid recessed reflector cones shall be Alzak with clear specular low iridescent finish.

- a. Incandescent fixtures shall comply with UL 1571. Incandescent

fixture specular reflector cone trims shall be integral to the cone and shall be finished to match. Painted trim finishes shall be white with minimum reflectance of 88%. Low voltage incandescent fixtures shall have integral step-down transformers.

- b. Fluorescent fixtures shall comply with UL 1570. Recessed ceiling fixtures shall comply with NEMA LE 4. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles. Fluorescent fixture lens frames on recessed and surface mounted troffers shall be one assembly with mitered corners. Parabolic louvers shall have a low iridescent finish and 45 degree cut-off. Louver intersection joints shall be hairline type and shall conceal mounting tabs or other assembly methods. Louvers shall be free from blemishes, lines or defects which distort the visual surface. Integral ballast and wireway compartments shall be easily accessible without the use of special tools. Housings shall be constructed to include grounding necessary to start the lamps. Open fixtures shall be equipped with a sleeve, wire guard, or other positive means to prevent lamps from falling. Medium bi-pin lampholders shall be twist-in type with positive locking position. Long compact fluorescent fixtures and fixtures utilizing U-bend lamps shall have clamps or secondary lampholders to support the free ends of the lamps.
- c. High intensity discharge fixture shall comply with UL 1572. Recessed ceiling fixtures shall comply with NEMA LE 4. Reflectors shall be anodized aluminum. Fixtures for horizontal lamps shall have position oriented lampholders. Lampholders shall be pulse-rated to 5,000 volts. Fixtures indicated as classified or rated for hazardous locations or special service shall be designed and independently tested for the environment in which they are installed. Recessed lens fixtures shall have extruded aluminum lens frames. Ballasts shall be integral to fixtures and shall be accessible without the use of special tools. Remote ballasts shall be encased and potted. Lamps shall be shielded from direct view with a UV absorbing material such as tempered glass, and shall be circuited through a cut-off switch which will shut off the lamp circuit if the lens is not in place.
- d. Emergency lighting fixtures and accessories shall be constructed and independently tested to meet the requirements of applicable codes. Batteries shall be Nicad or equal with no required maintenance, and shall have a minimum life expectancy of five years and warranty period of three years.
- e. Exit Signs

Exit signs shall be ENERGY STAR compliant, thereby meeting the following requirements. Input power shall be less than 5 watts per face. Letter size and spacing shall adhere to NFPA 101. Luminance contrast shall be greater than 0.8. Average luminance shall be greater than 15 cd/m<sup>2</sup> measured at normal (0 degree) and 45 degree viewing angles. Minimum

luminance shall be greater than  $8.6 \text{ cd/m}^2$  measured at normal and 45 degree viewing angles. Maximum to minimum luminance shall be less than 20:1 measured at normal and 45 degree viewing angles. The manufacturer warranty for defective parts shall be at least 5 years.

#### 2.10.4 Lighting Fixtures

Type A - 500-watt low-glare, surface-mounted ellipsoidal halogen fixture, with a beam spread of 60 degrees, and peak candela at approximately 19 degrees above nadir. Fixture shall be fabricated using a cylindrical aluminum housing/heat sink assembly, and a two-stage specular Alzak reflector assembly. Fixture shall be finished in a factory-applied, high-temperature custom paint. Lamp shall be frosted, with a heavy-duty filament and mini-can base. Fixture shall be similar in size, quality, physical characteristics and performance to Kurt Versen L395 series.

Type A-1 - 250-watt low-glare, pendant-mounted ellipsoidal halogen fixture, with a beam spread of 52 degrees, and peak candela at approximately 16 degrees above nadir. Fixture shall be fabricated using a cylindrical aluminum housing/heat sink assembly, and a two-stage specular Alzak reflector assembly. Fixture, stem and canopy shall be finished in a factory-applied, high-temperature custom paint. Lamp shall be frosted, with a heavy-duty filament and mini-can base. Fixture shall be similar in size, quality, physical characteristics and performance to Kurt Versen L394.

Type A-2 - 150-watt low-glare, pendant-mounted ellipsoidal halogen fixture, with a beam spread of 90 degrees, and peak candela at approximately 25 degrees above nadir. Fixture shall be fabricated using a cylindrical aluminum housing, and a single-stage specular Alzak reflector. Fixture, stem and canopy shall be finished in a factory-applied, high-temperature custom paint. Lamp shall be frosted, Halogena-style with medium screw base. Fixture shall be similar in size, quality, physical characteristics and performance to Kurt Versen L321-P5 series.

Type B - Dimmable, conduit-mounted, 40-watt compact fluorescent, asymmetric wall-wash fixture. Fixture shall be fabricated using an extruded aluminum housing, a backlight visor, a multi-contoured reflector, and internal parabolic louvers providing 45 degree lateral shielding. The reflector shall be engineered to achieve peak candela aimed 25 degrees above nadir, with less than 10% spill light within the 0-25 degree zone. Fixture, conduit and supports shall be finished in a factory-applied, high-temperature custom paint. Lamp shall be 3000K, 85 CRI, 4-pin Biaxial T5 compact fluorescent. Ballast shall be high frequency, solid-state electronic dimming type, and shall be compatible with the dimming modules. Fixture shall be similar in size, quality, physical characteristics and performance to Windirect P1-LS-CFM42-LS9-SGB-SV.

Type C - Dimmable, pendant-mounted, 8' long linear 128-watt fluorescent twin upright, with integral dimming ballast and 96" stems. Fixture shall be fabricated using an extruded aluminum housing with front visor, and be continuous row-mounted to lengths as indicated. Fixture shall employ a multi-contoured reflector, with peak candela aimed 125 degrees above nadir, with less than 15% spill light within the 0-125 degree zone, and less than

3% spill light within the 180-270 degree zone. Fixture, stem and canopy shall be finished in a factory-applied, high-temperature custom paint. Lamps shall be 3000K, 85 CRI, T8 bi-pin. Ballasts shall be high frequency, solid-state dimming ballasts compatible with the dimming modules. Fixture shall be similar in size, quality, physical characteristics and performance to Windirect #P1-SS-296T8-SGB series.

Type D - Cable-mounted, two-lamp, 4' European-industrial 64-watt fluorescent fixture with parabolic louvers. Fixture shall be fabricated using an extruded aluminum housing channel, an aluminum contoured reflector assembly, and 1-1/2" high by 2-1/2" O.C., precisely aligned aluminum louvers. Lamps shall be 3000K, 85 CRI, T8 bi-pin. Fixture shall be similar in size, quality, physical characteristics and performance to Focal Point FEVS-PL series.

Type DR - Recessed, two-lamp, 4' long by 6" wide fixture with parabolic louvers. Fixture shall be fabricate using a 20 gauge formed steel housing and end caps. Lamps shall be 3000K, 85 CRI, T8 bi-pin. Fixture shall be similar in size, quality, physical characteristics, and performance to Linear Lighting #RC68-D2-ET8RS-120-PBL-G-NO-4'.

Type F - Track-mounted PAR halogen accent fixture with yoke bracket, heavy-duty accessory clips, and a micro-prismatic beam-softening lens. Fixture shall be fabricated using a spun aluminum housing, porcelain socket, heavy-duty track fitter, integrated on/off switch, and hinged front door. Lamp shall be 75-watt PAR-30 flood. Fixture shall be similar in size, quality, physical characteristics, and performance to LSI #280-00-W-A998.

Type F/T - Surface-mounted track system, with lengths, feeds, connectors as indicated. Track shall be fabricated using a nominal 2" by 2" extruded aluminum housing, with copper buss bars equivalent to #12 AWG wire for the hot and ground conductors, and #10AWG wire for the neutral conductor, and separate mechanical rotating attachment/support tabs. Track shall be similar in size, quality, physical characteristics and performance to LSI #31000 series.

Type G - Recessed 4-1/8" aperture incandescent downlight. Fixture to be fabricated using a formed steel enclosure and two-stage champagne gold Alzak reflector assembly top achieve 45 degree distribution, with peak candela at 23 degrees. Lamp shall be 100-watt halogen BT-15 frosted with medium screw base. Fixture shall be similar in size, quality, physical characteristics, and performance to Kurt Versen #C7320-SG.

Type H - Recessed 4-1/8" aperture, adjustable low-voltage accent fixture. Fixture shall be fabricated using a formed steel enclosure, champagne gold Alzak reflector, tilt and rotation locking mechanism, and re-lamping tilt-out feature. Fixture shall be similar in size, quality, physical characteristics and performance to Kurt Versen #K7430-SG.

Type J - Surface-mounted, cove pocket, linear wall-grazing system. Fixture shall be fabricated using a formed steel housing with internal wiring channel, with 0-10 degree lockable and adjustable porcelain sockets on 9" centers, and precisely formed, champagne gold Alzak aluminum baffles. Fixture lengths shall be as indicated. Lamps shall be 50-watt PAR 20

halogen spots. Fixture shall be similar in size, quality, physical characteristics and performance to Edison Price #SPR20-9G series.

Type K - Core-drilled, low-voltage, recessed steplight. Fixture shall be fabricated using a corrosion-resistant, cast silicone aluminum housing and faceplate, stainless steel hardware, silicone "O" ring gasket, with a diffused, tempered glass lens. Finish shall be Dark Bronze polyester powder paint. Lamp shall be 18-watt, 12-volt, double-contact bayonet base. Fixture shall be served by remote-mounted transformer as indicated, and shall be similar in size, quality, physical characteristics and performance to Lumiere' #1204-INC18-12-BZ.

Type L - Recessed line-voltage steplight. Fixture shall be fabricated using a cast aluminum housing and faceplate, and continuous internal gasket. Faceplate shall be finished in custom color polyester powder paint. Lamp shall be 10-watt, C7-type, double contact, with bayonet base. Fixture shall be similar in size, quality, physical characteristics, and performance to Belfer #3410FP-CC-S-51-120-10C7.

Type M - Exterior entrance canopy marquee flight strip. Fixture shall be fabricated using a 2" by 2" extruded aluminum channel, with internal wiring, porcelain sockets on 12" centers, and shall bear the UL wet-location label. Lengths shall be as indicated. Finish shall be satin aluminum. Lamps shall be 40-watt G25-type as indicated on the Fixture Schedule. Fixture shall be similar in size, quality, physical characteristics and performance to Belfer #2502-12-S-F-WL.

Type N - Under-cabinet fluorescent task light. Fixture shall be fabricated using

Refer to Lighting Fixture Schedule and List of Approved Equivalent Lighting Manufacturers for additional information.

Due to the specialized nature of the project, the Lighting Fixture Specifications are based on a single manufacturer, with one or two alternate manufacturers named as acceptable equivalents. Manufacturers other than those named will be considered, only under the following circumstances:

OPTION #1

Proposed alternate fixtures must be submitted for approval 10 business days prior to the bid date, including all technical and performance data required to allow for a complete and thorough evaluation.

Sample fixtures are to be provided, with cords, plugs and lamps to allow for a full-scale mock-up of the proposed alternate fixtures.

In the event that the evaluation results in acceptance of the proposed alternate, an addendum will be issued to formally include the additional manufacturers in the bid documents.

OPTION #2

Proposed alternate fixtures must be submitted with the bid form, including all technical and performance data required to allow for a complete and thorough evaluation.

Sample fixtures are to be provided, with cords, plugs and lamps to allow

for a full-scale mock-up of the proposed alternate fixtures. Submittals shall include the dollar amount of credit to be applied to the project, for use of the proposed alternate fixture. Amount of credit will be a factor in considering the value offered by the alternate fixtures.

#### STANDARD SPECIFICATION ITEM FOR PROJECTS WITH ADJUSTABLE FIXTURES

It is the responsibility of the electrical contractor to schedule a meeting with the owner and design team to accomplish the final aiming of all adjustable lighting fixtures. The contractor shall schedule the meeting to be conducted at dusk, and shall have available spare lamps, ladders, scaffolding, manpower, and associated hardware as may be required to complete the aiming to the satisfaction of the owner and design team.

The contractor shall then prepare a lamping chart indicating the proper lamp wattage and beam spread for lamps used in each light fixture. The lamping chart shall be submitted prior to final payment, and shall consist of a Reflected Ceiling Plan indicating lamps by symbol, and an accompanying symbol legend chart with complete lamp catalog numbers.

Any project fixtures used as temporary lighting during construction shall be cleaned free of all construction dirt, and re-lamped with new lamps prior to final acceptance.

#### 2.10.4.1 Performance Hall - House Lighting Controls

For routine daily use, preset wall control stations will be located throughout the facility.

Entrance controls will be two-button, single-gang devices, capable of activating one scene and off. These will be finished in a color to match the walls, and fitted with architecturally pleasing lockable covers or keyed lockout to limit access to authorized personnel. Quantity will be approximately eight devices.

Multi-scene controls will be ten-button, two-gang devices capable of activating eight different scenes and off, with secondary capability of up to 16 additional scenes. These will be located in the Main Hall and Supervisor's Office, and in public spaces, finished in a color to match the walls, and shall be fitted with architecturally pleasing lockable covers or keyed lockout to limit access to authorized personnel, where required. Quantity will be approximately eight devices.

During performances, the House lighting will be controlled through the theatrical lighting console, described in the Theatrical Lighting Section.

#### 2.10.4.2 Housing Lighting Control System Set-up and Commissioning

The manufacturer shall provide a field service technician for no less than three full days to perform the following for the House lighting controls to the Owner's satisfaction.

Certification of installation and system commissioning.

Beginning of minimum three-year warranty period.  
Owner orientation for system operation and troubleshooting.  
Set up of scene levels under the direction of the Lighting Consultant.  
These operations shall be videotaped for future reference.

#### 2.10.5 Lampholders, Starters, and Starter Holders

UL 542

#### 2.11 LOW-VOLTAGE FUSES AND FUSEHOLDERS

##### 2.11.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

##### 2.11.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

Fuses, Class G, J, L and CC shall be in accordance with UL 198C.

##### 2.11.3 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

##### 2.11.4 Fuseholders

UL 512.

#### 2.12 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

#### 2.13 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral horsepower, 500 hp and smaller shall conform to NEMA MG 1 and UL 1004 for motors and NEMA MG 10 for energy management selection of polyphase motors. In addition to the standards listed above, motors shall be provided with efficiencies as specified in the table "MINIMUM NOMINAL EFFICIENCIES" below.

##### 2.13.1 Rating

The horsepower rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

##### 2.13.2 Motor Efficiencies

All permanently wired polyphase motors of 1 hp or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 1 hp or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motor efficiencies indicated in the tables apply to general-purpose, single-speed, polyphase induction motors.



Applications which require definite purpose, special purpose, special frame, or special mounted polyphase induction motors are excluded from these efficiency requirements. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

MINIMUM NOMINAL MOTOR EFFICIENCIES  
OPEN DRIP PROOF MOTORS

<u>kW</u>	<u>1200 RPM</u>	<u>1800 RPM</u>	<u>3600 RPM</u>
0.746	82.5	85.5	80.0
1.12	86.5	86.5	85.5
1.49	87.5	86.5	86.5
2.24	89.5	89.5	86.5
3.73	89.5	89.5	89.5
5.60	91.7	91.0	89.5
7.46	91.7	91.7	90.2
11.2	92.4	93.0	91.0
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	93.6
44.8	95.0	95.0	94.1
56.9	95.0	95.0	94.5
74.6	95.0	95.4	94.5
93.3	95.4	95.4	95.0
112.0	95.8	95.8	95.4
149.0	95.4	95.8	95.4
187.0	95.4	96.2	95.8
224.0	95.4	95.0	95.4
261.0	94.5	95.4	95.0
298.0	94.1	95.8	95.0
336.0	94.5	95.4	95.4
373.0	94.5	94.5	94.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

<u>kW</u>	<u>1200 RPM</u>	<u>1800 RPM</u>	<u>3600 RPM</u>
0.746	82.5	85.5	78.5
1.12	87.5	86.5	85.5
1.49	88.5	86.5	86.5
2.24	89.5	89.5	88.5
3.73	89.5	89.5	89.5
5.60	91.7	91.7	91.0
7.46	91.7	91.7	91.7
11.2	92.4	92.4	91.7
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6

## TOTALLY ENCLOSED FAN-COOLED MOTORS

37.3	94.1	94.5	94.1
44.8	94.5	95.0	94.1
56.9	95.0	95.4	94.5
74.6	95.4	95.4	95.0
93.3	95.4	95.4	95.4
112.0	95.8	95.8	95.4
149.0	95.8	96.2	95.8
187.0	95.6	96.2	95.9
224.0	95.4	96.1	95.8
261.0	94.5	96.2	94.8
298.0	94.5	95.8	94.5
336.0	94.5	94.5	94.5
373.0	94.5	94.5	94.5

MINIMUM NOMINAL MOTOR EFFICIENCIES  
OPEN DRIP PROOF MOTORS

<u>HP</u>	<u>1200 RPM</u>	<u>1800 RPM</u>	<u>3600 RPM</u>
1	82.5	85.5	80.0
1.5	86.5	86.5	85.5
2	87.5	86.5	86.5
3	89.5	89.5	86.5
5	89.5	89.5	89.5
7.5	91.7	91.0	89.5
10	91.7	91.7	90.2
15	92.4	93.0	91.0
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	93.6
60	95.0	95.0	94.1
75	95.0	95.0	94.5
100	95.0	95.4	94.5
125	95.4	95.4	95.0
150	95.8	95.8	95.4
200	95.4	95.8	95.4
250	95.4	96.2	95.8
300	95.4	95.0	95.4
350	94.5	95.4	95.0
400	94.1	95.8	95.0
450	94.5	95.4	95.4
500	94.5	94.5	94.5

## TOTALLY ENCLOSED FAN-COOLED MOTORS

<u>HP</u>	<u>1200 RPM</u>	<u>1800 RPM</u>	<u>3600 RPM</u>
1	82.5	85.5	78.5
1.5	87.5	86.5	85.5
2	88.5	86.5	86.5
3	89.5	89.5	88.5

TOTALLY ENCLOSED FAN-COOLED MOTORS			
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	94.1
60	94.5	95.0	94.1
75	95.0	95.4	94.5
100	95.4	95.4	95.0
125	95.4	95.4	95.4
150	95.8	95.8	95.4
200	95.8	96.2	95.8
250	95.6	96.2	95.9
300	95.4	96.1	95.8
350	94.5	96.2	94.8
400	94.5	95.8	94.5
450	94.5	94.5	94.5
500	94.5	94.5	94.5

## 2.14 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

### 2.14.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

### 2.14.2 Motor Starters

Combination starters shall be provided with motor-circuit protector type circuit breakers.

#### 2.14.2.1 Reduced-Voltage Starters

Reduced-voltage starters shall be provided for polyphase motors as indicated. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starter or part winding increment starter having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

### 2.14.3 Thermal-Overload Protection

Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided

either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

#### 2.14.4 Low-Voltage Motor Overload Relays

##### 2.14.4.1 General

Thermal overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70. Standard units shall be used for motor starting times up to 7 seconds. Slow units shall be used for motor starting times from 8 to 12 seconds.

##### 2.14.4.2 Construction

Manual reset type thermal relay shall be bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

##### 2.14.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 18 degrees F, an ambient temperature-compensated overload relay shall be provided.

#### 2.14.5 Automatic Control Devices

##### 2.14.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate horsepower rating.

##### 2.14.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

##### 2.14.5.3 Manual/Automatic Selection

- a. Where combination manual and automatic control is specified and

the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.

- b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.
- c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

#### 2.14.6 Motor Control Centers

Control centers shall conform to the requirements of NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2, Class I, Type B. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Motor control centers shall be provided with a full-length ground bus bar. See Section 16403 for additional requirements.

#### 2.15 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67. See Section 16403A for additional requirements.

#### 2.16 RECEPTACLES

##### 2.16.1 Heavy Duty Grade

NEMA WD 1. Devices shall conform to all requirements for heavy duty receptacles.

##### 2.16.2 Ground Fault Interrupters

UL 943, Class A or B.

##### 2.16.3 NEMA Standard Receptacle Configurations

NEMA WD 6.

- a. Single and Duplex, 20-Ampere, 125 Volt

20-ampere, non-locking: NEMA type 5-20R, locking: NEMA type L5-20R.

b. 20-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-20R, locking: NEMA type L6-20R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-20R, locking: NEMA type L15-20R.

2.17 Service Entrance Equipment

UL 869A.

2.18 SPLICE, CONDUCTOR

UL 486C.

2.19 SWITCHBOARDS

Assemblies shall be metal-enclosed, freestanding general-purpose ventilated type in accordance with NEMA PB 2, UL 891, and IEEE C37.20.1 and shall be installed to provide front access. Busses shall be copper. Assembly shall be approximately 90 inches high; arrangement of circuit breakers and other items specified shall be as indicated. The withstand rating and interrupting capacity of the switchboards and circuit breakers shall be based on the maximum fault current available. See Seciton 16403A for additioanl requirements.

2.19.1 Circuit Breakers

Circuit breakers shall be molded-case circuit breakers.

2.19.2 Auxiliary Equipment

2.19.2.1 Instruments

Instruments shall be long scale, 6.8 inches minimum, semiflush rectangular, indicating or digital switchboard type, mounted at eye level.

- a. Ammeter, range 0 to 2000 amperes, complete with selector switch having off position and positions to read each phase current.
- b. Voltmeter, range 0 to 250 or 600 volts, complete with selector switch having off position and positions to read each phase to phase or to neutral voltage.

2.19.2.2 Control Switch

A control switch with indicating lights shall be provided for each electrically operated breaker.

2.19.2.3 Control Power Sources

Control buses and control power transformers shall conform to the

requirements of Section 16311A MAIN ELECTRIC SUPPLY STATION AND SUBSTATION, where required. Control power shall be 120-volt AC.

## 2.20 SNAP SWITCHES

UL 20.

## 2.21 TAPES

### 2.21.1 Plastic Tape

UL 510.

### 2.21.2 Rubber Tape

UL 510.

## 2.22 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with delta-wye windings, except as indicated. "T" connections may be used for transformers rated 15 kVA or below. Transformers supplying non-linear loads shall be UL listed as suitable for supplying such loads with a total K-factor not to exceed K-13 and have neutrals sized for 200 percent of rated current.

### 2.22.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature rise not exceeding 80 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 80 degrees C temperature rise shall be capable of carrying continuously 130 percent of nameplate kVA without exceeding insulation rating.

#### a. 600 Volt or Less Primary:

NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, ventilated. Transformers shall be provided in NEMA 1 or 3R enclosure. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

## 2.23 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

## 2.24 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment and system constructed meet the specified requirements for equipment ratings,

coordination, and protection. They shall include a load flow analysis, a fault current analysis, and protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

#### 2.24.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

#### 2.24.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall coordinate with the Ft. Myer DPW Facilities for fault current availability at the site.

#### 2.24.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provide, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

#### 2.24.4 Fault Current Analysis

##### 2.24.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

##### 2.24.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

##### 2.24.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.



## 2.24.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situation where system coordination is not achievable due to device limitations (an analysis of any device curves which order overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

## 2.24.6 Study Report

- a. The report shall include a narrative: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.
- b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.
- c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device curves and protective device ratings and settings.
- d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.
- e. The report shall provide the calculations performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

## 2.25 SPECIAL EQUIPMENT

## 2.25.1 Outdoor Pad-Mounted Power Conditioner AV-DPU

Outdoor pad-mounted power conditioner AV-DPU shall be an electronic, industrial voltage regulator -- power conditioner with the following features:

Rating: 150 kVA, 480 Volt Input, 120/208Volt output, 3 phase

Standard +10% to -27% voltage input

+/-3% isolated output

One cycle response

No overload limitations

No minimum load required

No power factor limitations

No load type limitations

No moving parts, no maintenance

Integral surge suppression

Integral input circuit breaker

Diagnostic Display

Remote all contacts and remote alarm panel

Each phase independently corrected

Outdoor, weather-shield enclosure

Manual adjustment of output voltage

Manufacturer: Utility Systems Technologies "Sure-Volt" Model  
EVR-0150-480D-120-R-0-Q, or approved equal.

2.25.2 AV System Balanced Technical Power Panels BP-1, BP-2, BP-3, BP-4,  
BP-5 and BP-6

AV System Balanced Technical Power Panels BP-1, BP-2, BP-3, BP-4, BP-5 and  
BP-6 shall be factory pre-assembled power distribution centers with the  
following features:

Voltage - 120/208, single phase with (10)20A. 2P. breakers

Output voltage - 120 VCT

Capacity - 104A.

Integral toroid isolation transformer

Industrial duty AC distribution panelboard

Commercial grade circuit breakers

Transient voltage surge protection - 240 joules

Ground Fault Circuit Interrupters

EMI/RFI filters

NEMA 12 steel cabinet with hinged, lockable, gasketed door

Cabinet: 3" wide x 42" high x 8" deep

Manufacturer: Equi-Tech Model 12.5W, or approved equal.

#### 2.25.3 Company Switch/Panel

Company switch/panel shall be 120/208V., 3 Phase, 60 hZ, 5-wire panel with 200A., 3P. 3 Phase circuit breaker disconnect switch. Manufacturer: Union Connector Polybox, Part #PBS-M1010W-C/SP in NEMA 1 enclosure, or approved equal.

### PART 3 EXECUTION

#### 3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

##### 3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, use additional rods not less than 6 feet on centers. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

##### 3.1.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

### 3.1.3 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

### 3.1.4 Grounding for Audio Visual Equipment

Provide a star-patterned grounding system with a single point ground at the A/V transformer. Connect transformer to electric service ground. Connection to be maximum 5 ohms. Bond ground to Company switch to single point ground. Provide conductors to all racks, maximum 0.1 ohm. Verify conductor sizes. See "EA" Drawings for additional requirements.

## 3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit, electrical metallic tubing, intermediate metal conduit, minimum 3/4" conduit. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified.

### 3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 1/2 inch. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only within buildings. EMT may be installed in concrete and grout in dry locations. EMT installed in concrete or grout shall be provided with concrete tight fittings. EMT shall not be installed in damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Penetrations of above grade floor slabs, time-rated

partitions and fire walls shall be firestopped in accordance with Section 07840A FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 6 inches away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding.

#### 3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 50 feet in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 150 feet in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 200 pounds per square inch tensile strength. Not less than 10 inches of slack shall be left at each end of the pull wire.

#### 3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 6 inches above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

#### 3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

#### 3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than one inch from the reinforcing steel.

### 3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

### 3.2.1.6 Supports

Metallic conduits and tubing, and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 10 feet and within 3 feet of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

### 3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

### 3.2.1.8 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 50 feet for 1/2 inch and 3/4 inch sizes, and 100 feet for 1 inch or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 1 inch size or larger shall not be less than ten times the nominal diameter.

### 3.2.2 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

#### 3.2.2.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 100 feet long and of 277 volts more than 230 feet long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

#### 3.2.2.2 Cable Systems

Cable systems shall be installed where indicated. Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline of wood members; notching of surfaces will not be permitted. Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed cables shall be installed parallel or at right angles to walls or structural members. In rooms or areas not provided with ceiling or wall finish, cables and outlets shall be installed so that a room finish may be applied in the future without disturbing the cables or resetting the boxes. Exposed nonmetallic-sheathed cables less than 4 feet above floors shall be protected from mechanical injury by installation in conduit or tubing.

#### 3.2.2.3 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

- a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and

larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.

#### 3.2.2.4 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made.

Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

- a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).

277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C).

- b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 3 inches of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.
- c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

#### 3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 48 inches above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 24 inches. The total



combined area of all box openings in fire rated walls shall not exceed 100 square inches per 100 square feet. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

### 3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways shall be listed for the intended use when located in normally wet locations, when flush or surface mounted on outside of exterior surfaces, or when located in hazardous areas. Boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 4 inches square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 3/32 inch wall thickness are acceptable. Large size boxes shall be NEMA 1 or 3R or as shown. Boxes in other locations shall be sheet steel. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

### 3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 1-1/2 inches into reinforced-concrete beams or more than 3/4 inch into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 1 inch long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 12 inch long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

### 3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 1/4 inch from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be

mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

#### 3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box.

#### 3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of satin finish corrosion resistant steel. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

#### 3.5 RECEPTACLES

##### 3.5.1 Single and Duplex, 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be brown to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

### 3.5.2 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated; "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

#### 3.5.2.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

#### 3.5.2.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use.

### 3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be brown. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 120/277-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

### 3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the enclosed molded-case circuit breaker type or fusible safety switch type with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

### 3.8 PANELBOARDS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed

alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper.

#### 3.8.1 Panelboards

Panelboards shall be circuit breaker or fusible switch equipped as indicated on the drawings. Fusible panelboards of the multipole type may have doors over individual circuits and trim over the wiring gutter only, provided each circuit is arranged for locking in the open and closed positions and each branch circuit has an individual identification card in a cardholder with a clear plastic covering. Multipole fusible switches shall be of the hinged-door type; single pole fusible switches shall be of the tumbler switch and fuse type. Switches serving as a motor disconnect means shall be of the tumbler switch and fuse type. Switches serving as motor disconnect means shall be horsepower rated in conformance with UL 98.

#### 3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination. Time-delay and non-time-delay options shall be as specified.

##### 3.9.1 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds.

##### 3.9.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK5 shall have tested interrupting capacity not less than 200,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

#### 3.10 MOTORS

Each motor shall conform to the hp and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other

sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual horsepower ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

### 3.11 MOTOR CONTROL

Each motor or group of motors requiring a single control and not controlled from a motor-control center shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 1/8 hp or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate horsepower rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

#### 3.11.1 Reduced-Voltage Controllers

Reduced-voltage controllers shall be provided for polyphase motors as indicated. Reduced-voltage starters shall be of the single-step autotransformer, reactor, or resistor type having an adjustable time interval between application of reduced and full voltages to the motors. Wye-delta reduced voltage starters or part winding increment starters having an adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced voltage starters

specified above for starting of motor-generator sets, centrifugally operated equipment or reciprocating compressors provided with automatic unloaders.

### 3.11.2 Motor Control Centers

Control centers shall be indoor type and shall contain combination starters and other equipment as indicated. Control centers shall be NEMA ICS 2, Class I, Type B. Each control center shall be mounted on floor sills or mounting channels. Each circuit shall have a suitable metal or laminated plastic nameplate with white cut letters. Combination starters shall be provided with circuit breakers, fusible switches, switches equipped with high-interrupting-capacity current-limiting fuses. Motor control centers shall be provided with a full-length ground bus bar.

### 3.11.3 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

### 3.11.4 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

### 3.12 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

### 3.13 TRANSFORMER INSTALLATION

Three-phase transformers shall be connected only in a delta-wye configuration except isolation transformers having a one-to-one turns ratio. "T" connections may be used for transformers rated at 15 kVA or below. Dry-type transformers shown located within 5 feet of the exterior wall shall be provided in a weatherproof enclosure. Transformers to be located within the building may be provided in the manufacturer's standard, ventilated indoor enclosure designed for use in 40 degrees C ambient temperature, unless otherwise indicated.

### 3.14 LIGHTING FIXTURES, LAMPS AND BALLASTS

This paragraph shall cover the installation of lamps, lighting fixtures and ballasts in interior or building mounted applications.

#### 3.14.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15% of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. 10% spare lamps of each type, from the original manufacturer, shall be provided.

#### 3.14.2 Lighting Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on the drawings. Illustrations shown on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

##### 3.14.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

##### 3.14.2.2 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on or from the ceiling as shown. Installation and support of fixtures shall be in accordance with NFPA 70 and manufacturer's recommendations. Where seismic requirements are specified herein, fixtures shall be supported as shown or specified. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling, in conformance with UL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the ceiling panel structural supports.

##### 3.14.2.3 Fixtures for Installation in Grid Type Ceilings

Fixtures for installation in grid type ceilings which are smaller than a full tile shall be centered in the tile. 1 by 4 foot fixtures shall be mounted along the grid rail as shown. Work above the ceiling shall be coordinated among the trades to provide the lighting layout shown. Fixtures mounted to the grid shall have trim exactly compatible with the

grid. Contractor shall coordinate trims with ceiling trades prior to ordering fixtures. Metric fixtures shall be designed to fit the metric grid specified. Fixtures in continuous rows shall be coordinated between trades prior to ordering. Fixtures shall be mounted using independent supports capable of supporting the entire weight of the fixture. No fixture shall rest solely on the ceiling grid. Recessed fixtures installed in seismic areas should be installed utilizing specially designed seismic clips. Junction boxes shall be supported at four points.

#### 3.14.2.4 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers or hand-straightens so that they hang plumb. Pendants, rods, or chains 4 feet or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degrees of separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 10 feet or as recommended by the manufacturer, whichever is less.

Suspended fixtures installed in seismic areas shall have 45% swivel hangers and shall be located with no obstructions within the 45% range in all directions. The stem, canopy and fixture shall be capable of 45% swing.

#### 3.14.3 Ballasts

Remote type ballasts or transformers, where indicated, shall be mounted in a well ventilated, easily accessible location, within the maximum operating distance from the lamp as designated by the manufacturer.

### 3.15 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 6 feet or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

#### 3.15.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor



control centers and terminated.

### 3.16 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

### 3.17 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTS AND COATINGS.

### 3.18 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Government.

### 3.19 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 10 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

#### 3.19.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

#### 3.19.2 Ground-Resistance Tests

The resistance of each grounding electrode or the grounding grid shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of

separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Grid electrode - 5 ohms.

#### 3.19.3 Ground-Grid Connection Inspection

All below-grade ground-grid connections will be visually inspected by the Contracting Officer before backfilling. The Contractor shall notify the Contracting Officer 48 hours before the site is ready for inspection.

#### 3.19.4 Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

##### 3.19.4.1 Low Voltage Cable Tests

- a. Continuity test.
- b. Insulation resistance test.

#### 3.19.5 Motor Tests

- a. Phase rotation test to ensure proper directions.
- b. Operation and sequence of reduced voltage starters.
- c. High potential test on each winding to ground.
- d. Insulation resistance of each winding to ground.
- e. Vibration test.
- f. Dielectric absorption test on motor and starter.

#### 3.19.6 Dry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers.

- a. Insulation resistance test phase-to-ground, each phase.
- b. Turns ratio test.

### 3.19.7 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

#### 3.19.7.1 Circuit Breakers, Low Voltage

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Insulation resistance test phase-to-ground, each phase.
- c. Closed breaker contact resistance test.
- d. Manual and electrical operation of the breaker.

#### 3.19.7.2 Circuit Breakers, Molded Case

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Insulation resistance test phase-to-ground, each phase.
- c. Closed breaker contact resistance test.
- d. Manual operation of the breaker.

### 3.19.8 Motor Control Centers

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Insulation resistance test phase-to-ground, each phase.
- c. Manual and electrical operational tests.

### 3.20 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

### 3.21 FIELD SERVICE

#### 3.21.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training shall be submitted.

3.21.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of equipment, assist in the performance of the onsite tests, oversee initial operations, and instruct personnel as to the operational and maintenance features of the equipment.

3.22 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

## SECTION 16710A

PREMISES DISTRIBUTION SYSTEM  
09/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/TIA/EIA-568-B	(2001) Commercial Building Telecommunications Cabling Standard
EIA ANSI/TIA/EIA-568-B.2-1	(2002) Transmission Performance Specifications for 4-pair 100 ohm Category 6 Cabling
EIA ANSI/TIA/EIA-569-A	(2001) Commercial Building Standard for Telecommunications Pathways and Spaces
EIA ANSI/TIA/EIA-606A	(1993) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
EIA ANSI/TIA/EIA-607A	(1994) Commercial Building Grounding/Bonding Requirement Standard
EIA TIA/EIA-TSB-67	(1995) Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems

## IBM CORPORATION (IBM)

IBM GA27-3361-07	(1987) LAN Cabling System - Planning and Installation
IBM GA27-3773-0	(1987) Cabling System Technical Interface Specifications

## INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-83-596	(1994) Fiber Optic Premises Distribution Cable
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 50 (1995; Rev thru Nov 1999) Enclosures for  
Electrical Equipment

1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals between equipment items in a building.

1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Premises Distribution System; G

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

Installation; G

Record drawings for the installed wiring system infrastructure per EIA ANSI/TIA/EIA-606A. The drawings shall show the location of all cable terminations and location and routing of all backbone and horizontal cables. The identifier for each termination and cable shall appear on the drawings.

SD-03 Product Data

Record Keeping and Documentation; G

Documentation on cables and termination hardware in accordance with EIA ANSI/TIA/EIA-606A.

Manufacturer's Recommendations; G

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Test Plan; G

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; G

The qualifications of the Manufacturer, Contractor, and the Installer to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

SD-06 Test Reports

Test Reports;

Test reports in booklet form with witness signatures verifying execution of tests. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test reports shall be submitted within 14 days after completion of testing.

SD-07 Certificates

Premises Distribution System;

Written certification that the premises distribution system complies with the EIA ANSI/TIA/EIA-568-B.2-1, EIA ANSI/TIA/EIA-569-A, and EIA ANSI/TIA/EIA-606A standards.

Materials and Equipment;

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a

representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

Installers; G

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products.

## 1.5 QUALIFICATIONS

### 1.5.1 Minimum Contractor Qualifications

All work under this section shall be performed by and all equipment shall be furnished and installed by a certified Telecommunications Contractor, hereafter referred to as the Contractor. The Contractor shall have the following qualifications in Telecommunications Systems installation:

- a. Contractor shall have a minimum of 3 years experience in the application, installation and testing of the specified systems and equipment.
- b. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products.
- c. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

### 1.5.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

## 1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

## 1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.



## 1.8 RECORD KEEPING AND DOCUMENTATION

### 1.8.1 Cables

A record of all installed cable shall be provided in hard copy format per EIA ANSI/TIA/EIA-606A. The cable records shall include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility per EIA ANSI/TIA/EIA-606A.

### 1.8.2 Termination Hardware

A record of all installed patch panels and outlets shall be provided in hard copy format per EIA ANSI/TIA/EIA-606A. The hardware records shall include only the required data fields per EIA ANSI/TIA/EIA-606A.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

### 2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

#### 2.2.1 Horizontal Cable

Horizontal cable shall meet the requirements of EIA ANSI/TIA/EIA-568-B.2-1 for Category 6. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Cable shall be solid untinned copper (24 AWG) and rated CMG or CMP, as appropriate, per NFPA 70.

#### 2.2.2 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the cable it serves. Hardware shall be in accordance with EIA ANSI/TIA/EIA-568-B.

##### 2.2.2.1 Telecommunications Outlets

Outlet assemblies used in the premises distribution system shall consist of modular jacks assembled into both simplex and duplex outlet assemblies in single or double gang covers as specified in this section and as indicated on the drawings. Wall and desk outlet plates shall come equipped with two modular jacks, with the top or left jack labeled "voice" and the bottom or right jack labeled "data". Modular jacks shall be the same category as the cable they terminate and shall meet the requirements of EIA ANSI/TIA/EIA-568-B and shall meet the Link Test parameters as listed in EIA

TIA/EIA-TSB-67 and supplemented by EIA ANSI/TIA/EIA-568-B.2-1.. Modular jack pin/pair configuration shall be T568A per EIA ANSI/TIA/EIA-568-B. Modular jacks shall be unkeyed. Faceplates shall be provided and shall be stainless steel.

#### 2.2.2.2 Patch Panels

Patch panels shall consist of eight-position modular jacks, with rear mounted type 110 insulation displacement connectors, arranged in rows or columns on wall mounted panels. Jack pin/pair configuration shall be T568A per EIA ANSI/TIA/EIA-568-B. Jacks shall be unkeyed. Panels shall be provided with labeling space. The modular jacks shall conform to the requirements of EIA ANSI/TIA/EIA-568-B, and shall be rated for use with Category 6 cable in accordance with EIA ANSI/TIA/EIA-568-B.2-1 and shall meet the Link Test parameters as listed in EIA TIA/EIA-TSB-67 and supplemented by EIA ANSI/TIA/EIA-568-B.2-1.

#### 2.2.2.3 Patch Cords

Patch cords shall be cable assemblies consisting of flexible, twisted pair stranded wire with eight-position plugs at each end. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Patch cords shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568A patch panel jack wiring per EIA ANSI/TIA/EIA-568-B. Patch cords shall be unkeyed. Patch cords shall be factory assembled. Patch cords shall conform to the requirements of EIA ANSI/TIA/EIA-568-B.2-1 for Category 6.

#### 2.2.2.4 Terminal Blocks

Terminal blocks shall be mounted in cabinet with wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 110 which meet the requirements of EIA ANSI/TIA/EIA-568-B, and shall be rated for use with Category 6 cable in accordance with EIA ANSI/TIA/EIA-568-B.2-1 and shall meet the Link Test parameters as listed in EIA TIA/EIA-TSB-67 and supplemented by EIA ANSI/TIA/EIA-568-B.2-1. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

### 2.3 EQUIPMENT RACKS

#### 2.3.1 Wall Mounted Cabinets

Wall mounted cabinets shall conform to UL 50 and have boxes constructed of zinc-coated sheet steel with dimensions not less than shown on drawings. Trim shall be fitted with hinged door and flush catch. Doors shall provide maximum openings to the box interiors. Boxes shall be provided with 3/4 inch plywood backboard painted white or a light color. A duplex AC outlet shall be installed within the cabinet.

## 2.4 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 4-11/16 inch square by 2-1/8 inches deep with minimum 3/8 inch deep single or two gang plaster ring as shown. Provide a minimum 1 inch conduit.

## PART 3 EXECUTION

### 3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled in accordance with EIA ANSI/TIA/EIA-606A. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07840A FIRESTOPPING. Conduits, outlets and raceways shall be installed in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with EIA ANSI/TIA/EIA-568-B and as specified in Section 16415A ELECTRICAL WORK, INTERIOR. Wiring, and terminal blocks and outlets shall be marked in accordance with EIA ANSI/TIA/EIA-606A. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

#### 3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Copper cable not in a wireway shall be suspended a minimum of 8 inches above ceilings by cable supports no greater than 60 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed.

Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.

#### 3.1.2 Telecommunications Outlets

##### 3.1.2.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link.

##### 3.1.2.2 Cables

Unshielded twisted pair shall have a minimum of 6 inches of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

### 3.1.3 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized.

### 3.1.4 Unshielded Twisted Pair Patch Panels

Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 10 percent spares. Cable guides shall be provided above, below and between each panel.

## 3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

### 3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in EIA ANSI/TIA/EIA-568-B. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

## 3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with EIA ANSI/TIA/EIA-607A and Section 16415A ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

## 3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

- a. 2 of each type outlet.
- b. 2 of each type cover plate.
- c. 1 of each type terminal block for each telecommunications closet.
- d. 4 Patch cords of 6 feet.
- e. 1 Set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block.

### 3.5 ADMINISTRATION AND LABELING

#### 3.5.1 Labeling

##### 3.5.1.1 Labels

All labels shall be in accordance with EIA ANSI/TIA/EIA-606A.

##### 3.5.1.2 Cable

All cables will be labeled using color labels on both ends with encoded identifiers per EIA ANSI/TIA/EIA-606A.

##### 3.5.1.3 Termination Hardware

All workstation outlets and patch panel connections will be labeled using color coded labels with encoded identifiers per EIA ANSI/TIA/EIA-606A.

### 3.6 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made in accordance with the approved Test Plan submitted by the Contractor, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided. The Contractor shall submit Test Reports as they are completed.

#### 3.6.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These test shall be completed and all errors corrected before any other tests are started.

#### 3.6.2 Category 6 Circuits

All category 6 circuits shall be tested using a test set that meets the Class II accuracy requirements of EIA TIA/EIA-TSB-67 standard, including the additional tests and test set accuracy requirements of EIA ANSI/TIA/EIA-568-B.2-1. Testing shall use the Basic Link Test procedure of EIA TIA/EIA-TSB-67, as supplemented by EIA ANSI/TIA/EIA-568-B.2-1. Cables and connecting hardware which contain failed circuits shall be replaced and retested to verify the standard is met.

-- End of Section --